THE American JOURNAL OF Surgery

OCTOBER 1957

THURSTON SCOTT WELTON, M.D., EDITOR

SIXTY-SIXTH YEAR OF PUBLICATION

OCTOBER 1957

THE American JOURNAL OF Surgery

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1. Flocks, R. H.: J.A.M.A. *163*:709 (Mar. 2) 1957.
2. Flocks, R. H.; Marberger, H.; Begley, B. J., and Prendergast, L. J.: J. Urol. *74*:549, 1955.

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A series of forty patients received promethazine before and after maxillofacial operations which are prone to produce postoperative edema. The results indicate that promethazine does exert an antiedema effect. The incidence of postoperative nausea and vomiting was also reduced. The drug has no analgesic effects, but does minimize discomfort through its sedative action.

The Role of Ascaris Lumbricoides in Intestinal Perforations 542
JOSEPH V. CONROY

An attempt has been made to shed additional light on the helminth Ascaris lumbricoides as a causative agent of intestinal perforation. The author's opinion is that an enteric pathogen is always present in these apparent cases of roundworm perforation. The ascaris is simply a passenger within the intestinal lumen, and escapes into the peritoneal cavity through a preformed perforation caused by another enteric pathogen.

Primary Hodgkin's Disease of the Stomach 546
ARNOLD S. JACKSON

Primary Hodgkin's disease of the stomach is a rare condition (about thirty-six cases have been reported). The author reports three additional cases.

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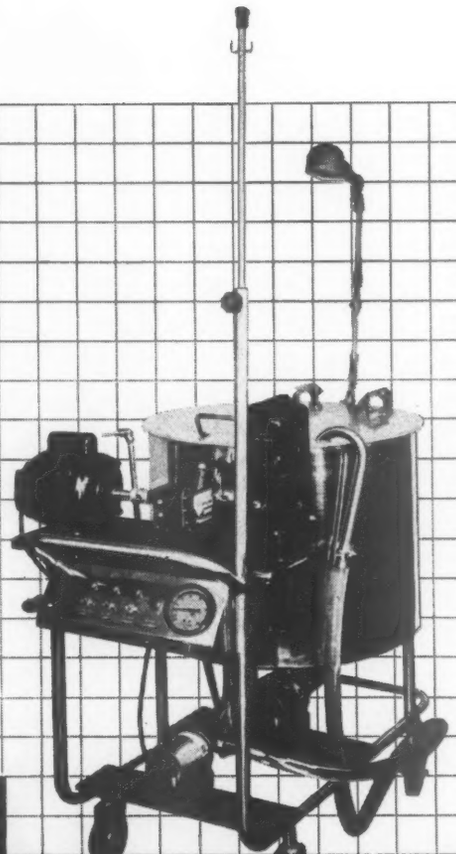

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Primary Lymphosarcomas of the Stomach. Report of Seven Cases 551

CHARLES E. FARMER AND AMBROSE J. HERTZOG

Seven cases of primary lymphosarcoma of the stomach were encountered at Touro Infirmary over a fourteen-year period as compared to 328 cases of carcinoma during same period. The presenting symptomatology was usually epigastric pain. These seven cases of primary lymphosarcoma are reported. The treatment of choice is radical surgery followed by postoperative radiation.

Diagnosis and Management of Acute Pancreatitis 558

JACK A. THOMPSON AND JOHN R. DERRICK

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RICHARD C. MCPHERSON, MITCHELL KARLAN AND ROGER D. WILLIAMS

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HARRY E. BACON

A series of patients with proved malignancy of the colon, rectum and anal canal is reported. Experience with an extended degree of radicality is cited, together with the results of aortoileopelvic lymphadenectomy. The incidence of five- and, in some instances, ten-year survivals is recorded.

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PAUL C. BLAISDELL

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GEORGE STRENGER

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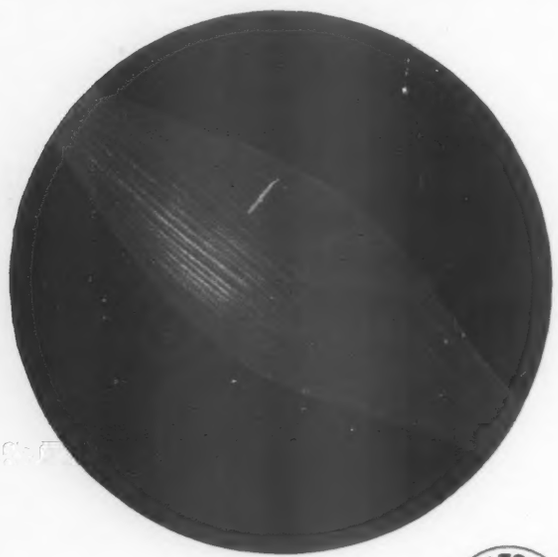

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MORTIMER HOUSBERG AND ABEL KENIN

Five cases of reticulum cell sarcoma of bone are presented. Primary reticulum cell sarcoma of bone is accepted as a separate entity and its favorable prognosis as compared to Ewing's tumor justifies its identity on more than a mere academic basis. To make this often difficult differential diagnosis, the assistance of a pathologist with wide experience in diseases of bone is essential.

A Practical Approach to the Management of Delayed Union and Non-union of the Long Bones 594

HAROLD M. BRODER AND JOHN H. CAUGHRAN

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S. D. SIKAND AND OTHO C. HUDSON

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Local Anesthesia for the Aged and Poor Risk Patient with Fracture of the Hip (137 Consecutive Operations) 604

ROBERT E. VAN DEMARK

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MILTON J. MARMER, BENJAMIN SIMKIN AND MARCUS H. RABWIN

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The Prevention of Postoperative Pulmonary Complications 611

JOHN J. FOMON

The general trend toward increased longevity has resulted in the performance of a greater number of major surgical procedures on patients in the older age group. Most of the pulmonary complications were atelectasis, pneumonia or a combination of the two. The author outlines in detail the prophylactic measures to protect these patients who are candidates for surgery. The postoperative regimen also is given.

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F. R. C. JOHNSTONE

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Acute Pancreatitis Associated with Acute Cholecystitis. The Curative Value of Biliary Tract Surgery 621

MELVIN A. BLOCK, JORGE PUIG-LACALLE AND LAURENCE S. FALLIS

Acute pancreatitis associated with acute cholecystitis is usually mild in severity and will subside with conservative therapy. The records of 452 cases in which the diagnosis of acute pancreatitis was made between the years 1935 and 1955 are reviewed; of these, sixty constitute the basis of this study.

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HERMAN SHANN

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PAUL F. NORA AND PAUL R. ROSENBLUTH

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KORNEL J. FOJCIK

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Excision of Acute Pilonidal Cyst Abscess. A Preliminary Report 636

HARRY A. FEIGENBAUM

In this report the author concludes that excision of an acute pilonidal cyst abscess is safe, shortens the duration of the ailment, and so far has given satisfactory results. The preoperative care, the technic of the operative procedure and the aftercare are outlined.

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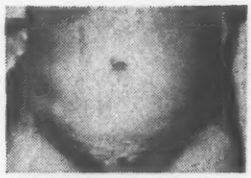

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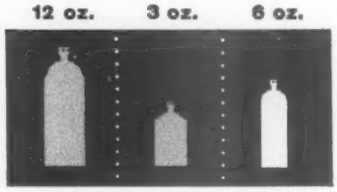

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SURGICAL REVIEW

Aneurysm of the Renal Artery 638

ANTHONY P. GARRITANO

A short review of aneurysms of the renal artery. Included is a historical review, classification, etiology, complications, occurrence, symptoms and signs, diagnosis and treatment.

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GEORGE CRILE, JR. AND ALFRED W. HUMPHRIES

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GILBERT D. FISH, JR. AND MARTIN HOCHHAUSER

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SIDNEY K. WYNN

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WILLIAM G. ABEL

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WALTER R. GILLETTE, JR. AND PAUL E. ZOLTOWSKI

Report of a case of foreign body (fish bone) perforation of a Meckel's diverticulum. Diagnosis and treatment are discussed.

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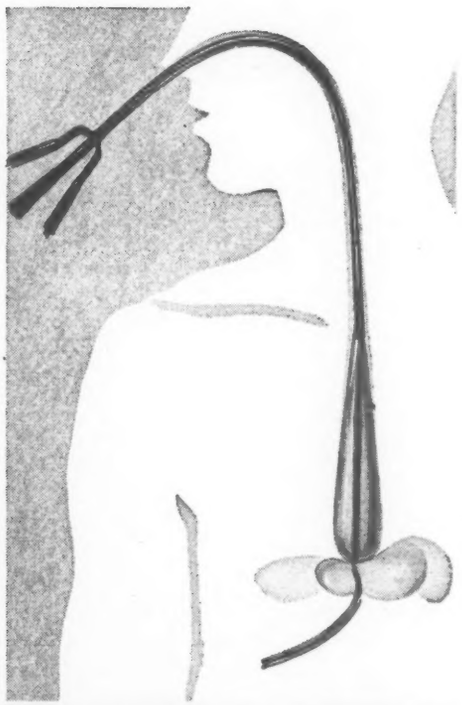

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True Diverticulum of the Prepyloric Area of the Stomach 669

F. E. MONTAGUE AND J. C. THOROUGHMAN

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JAMES L. RICHIE

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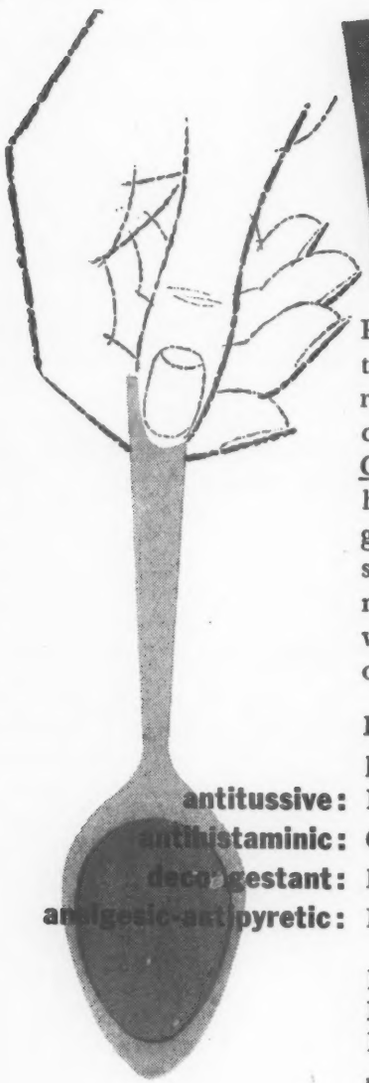

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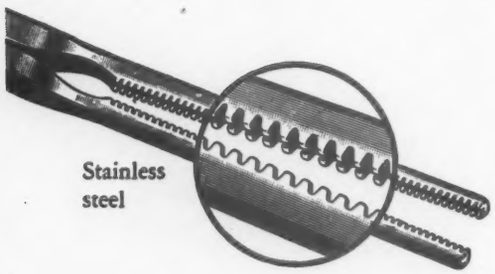

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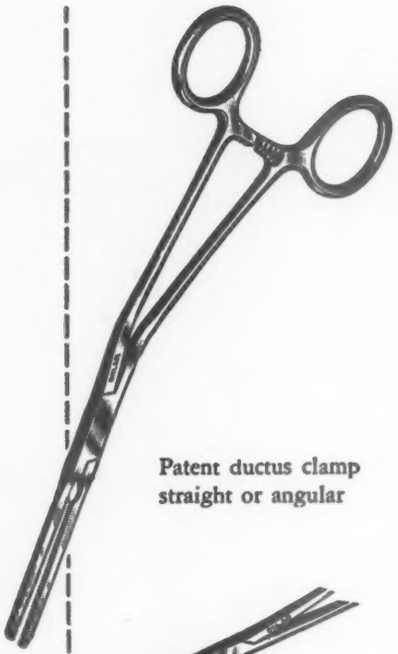

Patent ductus clamp
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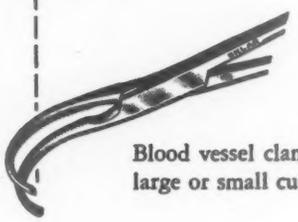

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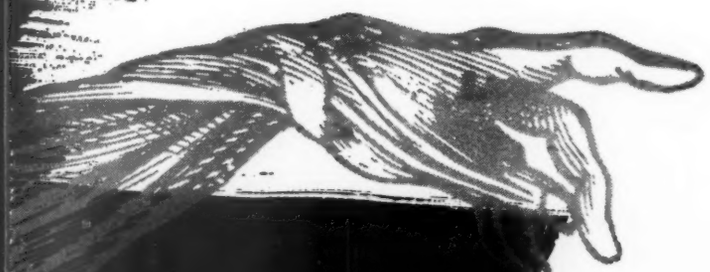


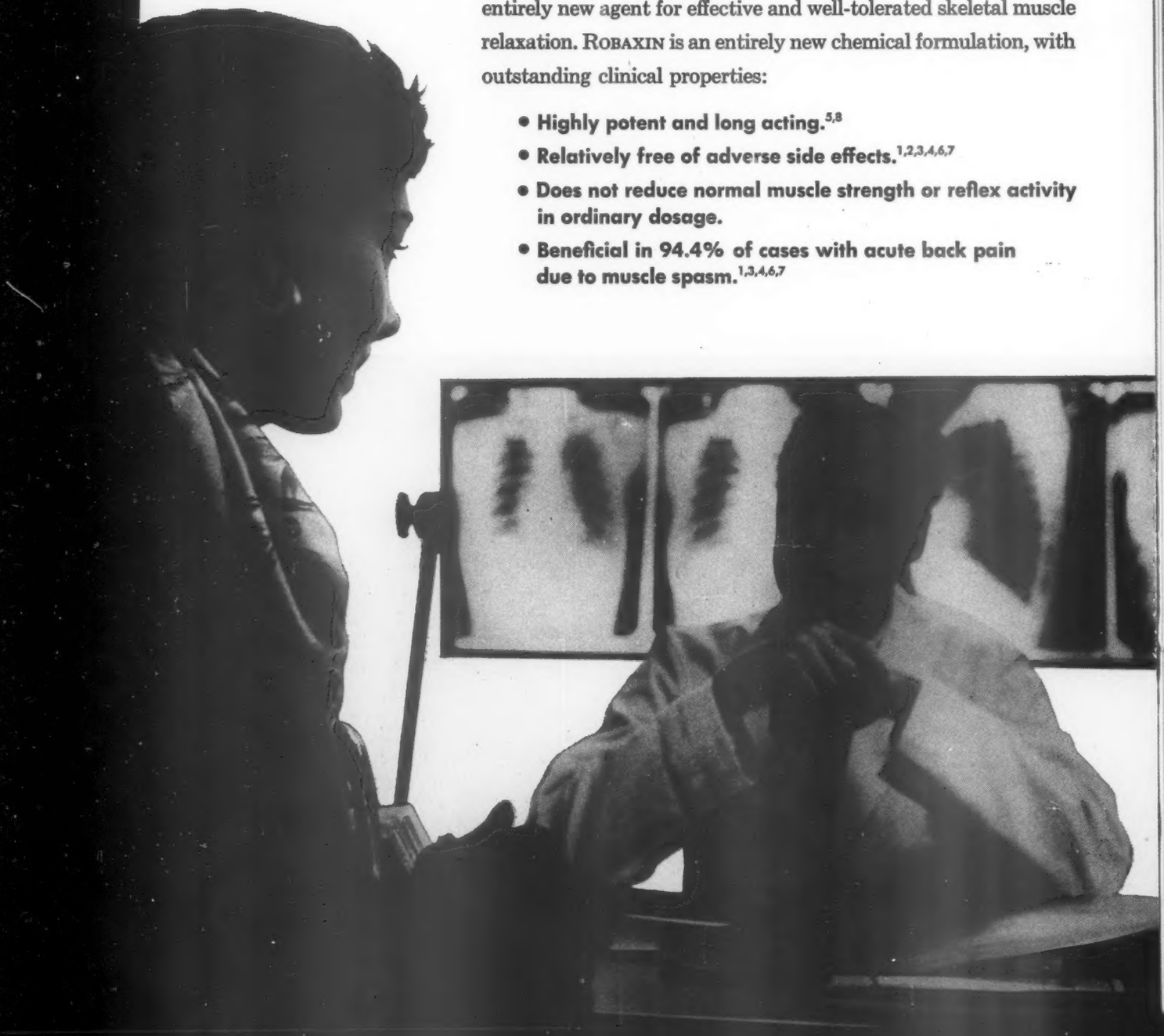
Significant Robins research discovery:

a highly efficient skeletal muscle relaxant

Ro

ROBAXIN – synthesized in the Robins Research Laboratories, and intensively studied for five years – introduces to the physician an entirely new agent for effective and well-tolerated skeletal muscle relaxation. ROBAXIN is an entirely new chemical formulation, with outstanding clinical properties:

- **Highly potent and long acting.**[5,8]
- **Relatively free of adverse side effects.**[1,2,3,4,6,7]
- **Does not reduce normal muscle strength or reflex activity in ordinary dosage.**
- **Beneficial in 94.4% of cases with acute back pain due to muscle spasm.**[1,3,4,6,7]



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(Methocarbamol Robins, U.S. Pat. No. 2770649)

Highly specific action

ROBAXIN is highly specific in its action on the internuncial neurons of the spinal cord – with inherently sustained repression of multisynaptic reflexes, but with no demonstrable effect on monosynaptic reflexes. It thus is useful in the control of skeletal muscle spasm, tremor and other manifestations of hyperactivity, as well as the pain incident to spasm, without impairing strength or normal neuromuscular function.

Beneficial in 94.4% of cases tested

When tested in 72 patients with acute back pain involving muscle spasm, ROBAXIN induced marked relief in 59, moderate relief in 6, and slight relief in 3 – or an over-all beneficial effect in 94.4%.[1,3,4,6,7] No side effects occurred in 64 of the patients, and only slight side effects in 8. In studies of 129 patients, moderate or negligible side effects occurred in only 6.2%.[1,2,3,4,6,7]

CLINICAL RESULTS WITH ROBAXIN IN ACUTE BACK PAIN[1, 3, 4, 6, 7]

Disease entity	*No. of Cases*	*Duration of Treatment*	*Dose per day (divided)*	*Response*				*Side Effects*
				Marked	*Mod.*	*Slight*	*Neg.*	
Acute back pain due to								
(a) Muscle spasm secondary to sprain	18	2-42 days	3-6 Gm.	17	1	0	0	None, 16; Dizziness, 1; Slight nausea, 1.
(b) Muscle spasm due to trauma	13	1-42 days	2-6 Gm.	8	1	3	1	None, 12; Nervousness, 1.
(c) Muscle spasm due to nerve irritation	5	4-240 days	2.25-6 Gm	4	1	0	0	None, 5.
(d) Muscle spasm secondary to discogenic disease and postoperative orthopedic procedures	30	2-28 days	1.5-9 Gm.	24	3	0	3	None, 25; Dizziness, 1; Lightheadedness, 2; Nausea, 2.*
Miscellaneous (bursitis, torticollis, etc.)	6	3-60 days	4-8 Gm.	6	0	0	0	None, 6.
TOTAL	72			59	6	3	4	

*Relieved on reduction of dose

A PRODUCT OF ROBINS RESEARCH

NOW

a highly specific skeletal muscle relaxant...

Robaxin®

Robins

(Methocarbamol Robins)

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Indications:

Acute back pain associated with: (a) muscle spasm secondary to sprain; (b) muscle spasm due to trauma; (c) muscle spasm due to nerve irritation; (d) muscle spasm secondary to discogenic disease and postoperative orthopedic procedures; and (e) miscellaneous conditions such as bursitis, torticollis, and related conditions.

Dosage:

ADULTS: 2 tablets 4 times a day to 3 tablets 6 times a day.

CHILDREN: Total daily dosage 270 to 335 mg. per 10 pounds of body weight, adjusted for age and weight, and divided into 4 to 6 doses per day.

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References:

1. Carpenter, E. B.: Publication pending.
2. Carter, C. H.: Personal communication.
3. Forsyth, H. F.: Publication pending.
4. Freund, J.: Personal communication.
5. Morgan, A. M., Truitt, E. B., Jr., and Little, J. M.: J. American Pharm. Assn. 46:374, 1957.
6. Nachman, H. M.: Personal communication.
7. O'Doherty, D.: Publication pending.
8. Truitt, E. B., Jr., and Little, J. M.: J. Pharm. & Exper. Therap. 119:161, 1957.

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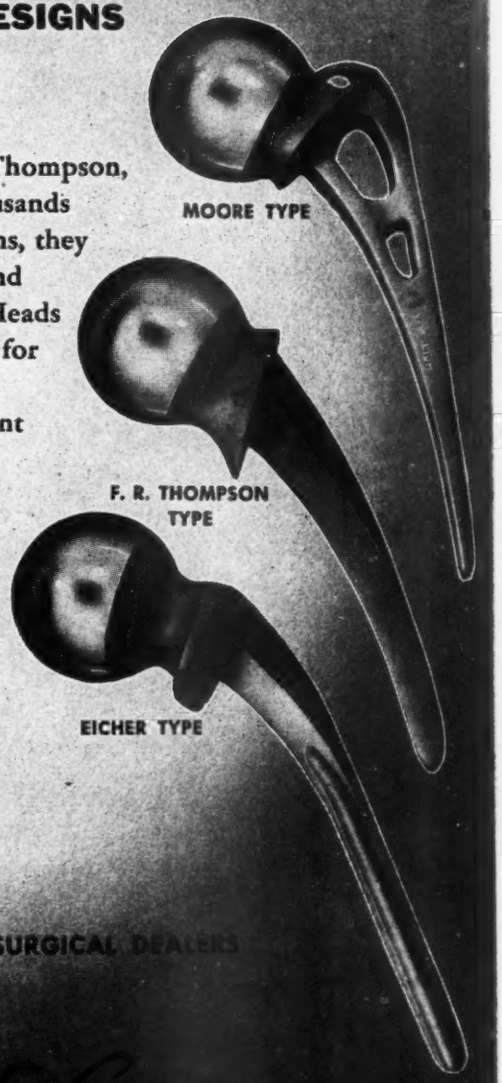

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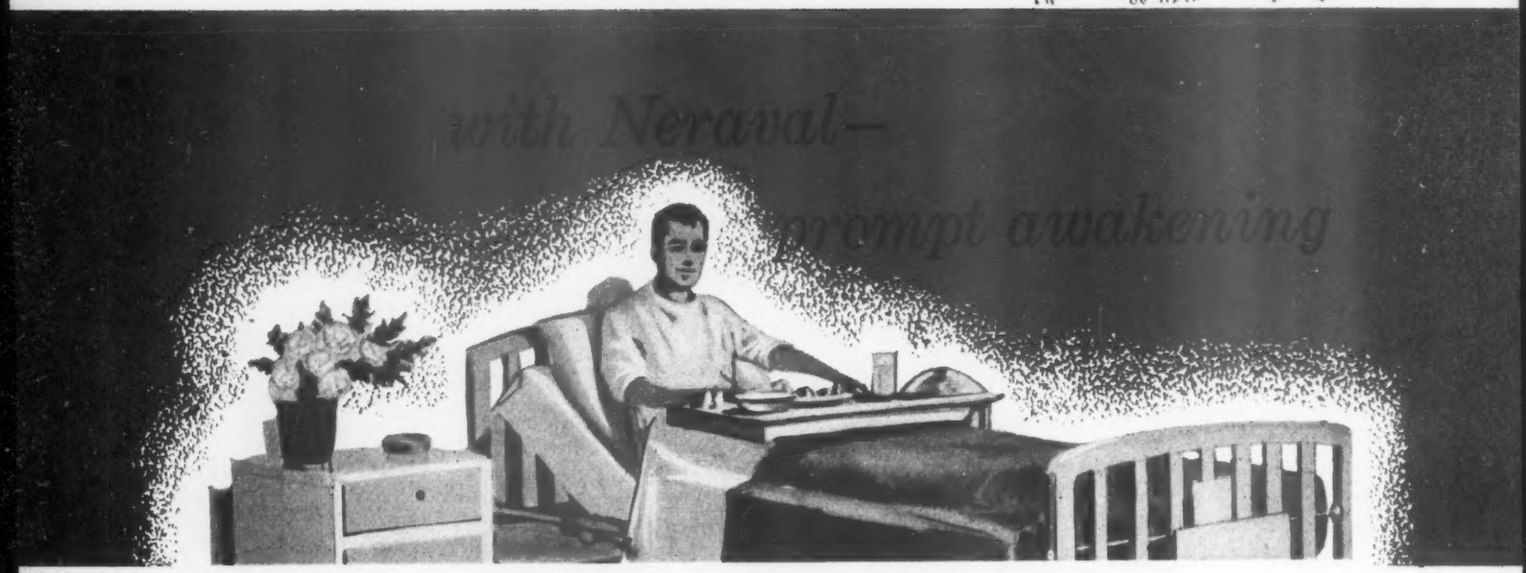

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Bibliography:
(1) Boone, J. D.; Muñoz, R., and Dillon, J. B.: Anesthesiology *17*:284, 1956. (2) Zima, O.; von Werder, F., and Hotovy, R.: Anaesthesist *3*:244, 1954. (3) Mersch, M. A.; Clarie, D'A., and Fitzpatrick, L. J.: J.M. Soc. New Jersey *53*:414, 1956. (4) Blake, M. W., and Perlman, P. L.: J. Pharmacol. & Exper. Therap. *117*:287, 1956. (5) Irwin, S.; Stagg, R. D.; Dunbar, E., and Govier, W. M.: J. Pharmacol. & Exper. Therap. *116*:317, 1956. (6) Ayd, F. J., Jr.: Neraval: A new anesthetic for electroconvulsive therapy, Paper presented at annual meet., Electroshock Research Association, Chicago, Illinois, April 29, 1956. (7) Reifferscheid, M., and Dietmann, K.: Deutsche med. Wchnschr. *79*:638, 1954. (8) Houde, J.; Hudon, F., and Jacques, A.: Neraval (methitural sodium), Paper presented at Meet., Canad. Anaesth. Soc., Quebec City, P. Q., May 5, 1956.

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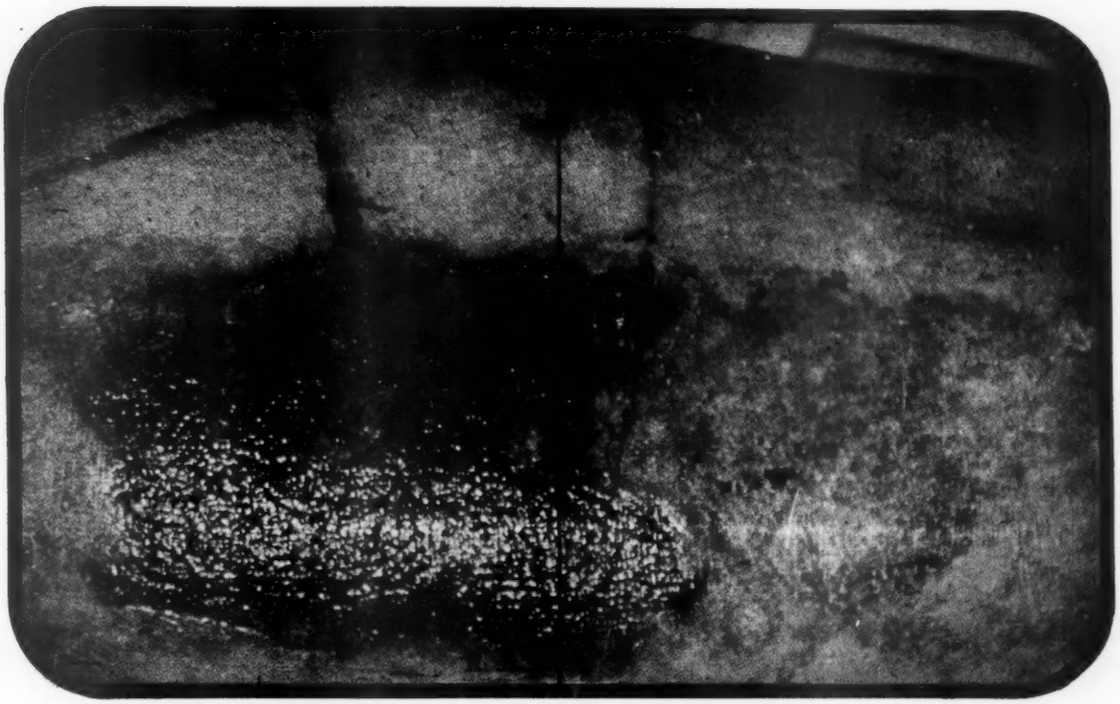

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Jeffords, J. V., and Hagerty, R. F.: Ann. Surg. *145*:169, 1957.

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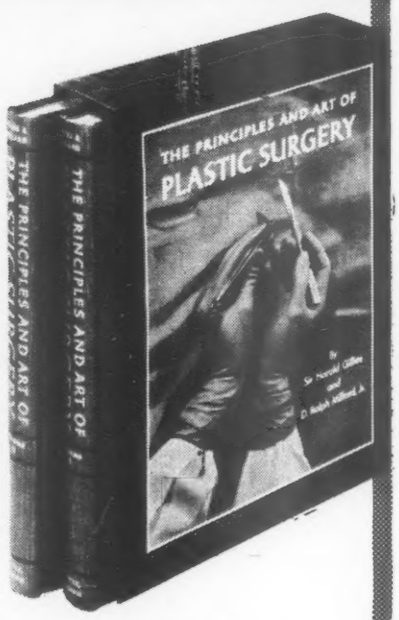

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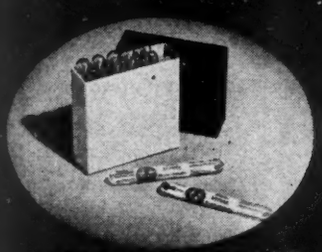

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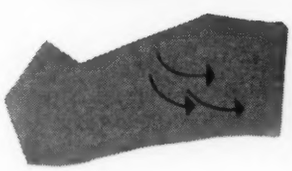

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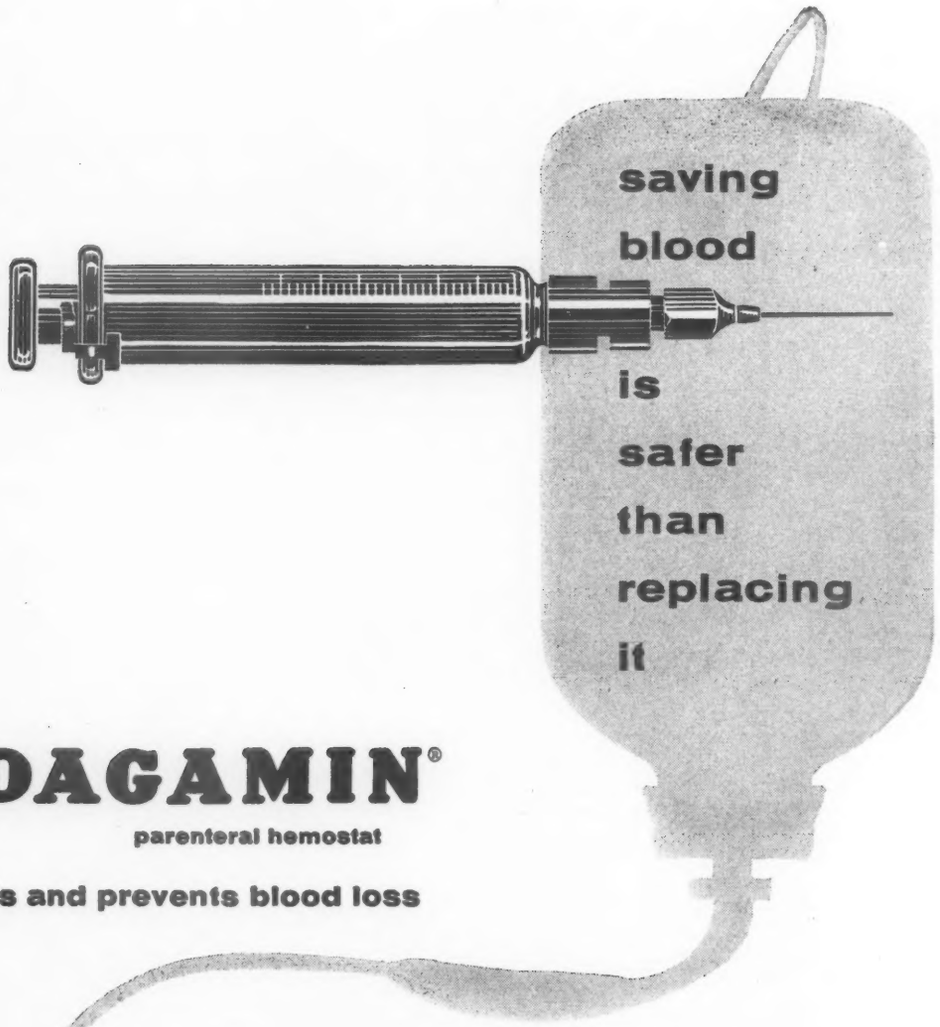

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1. Joseph, M.: Control of Hemorrhage—or Transfusion, Am. J. Surg. *87*:905, 1954. 2. Crisp, W. E.: Editorial; One Pint of Blood, Obst. & Gynec. *7*:216, 1956.

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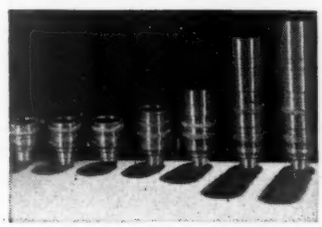

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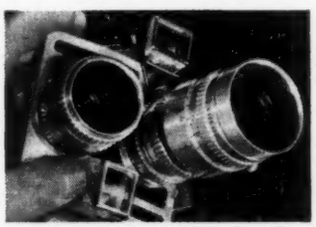

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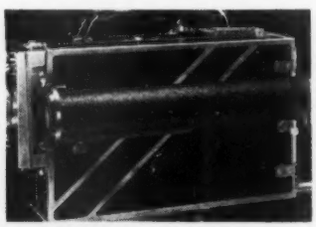

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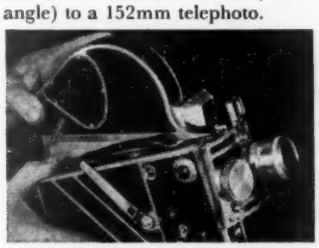

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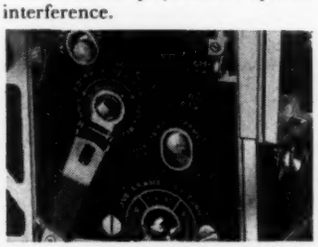

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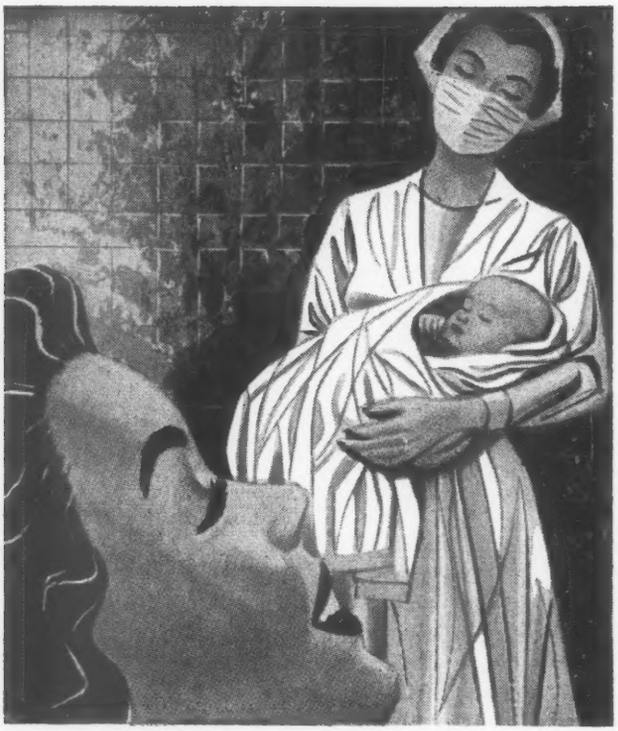

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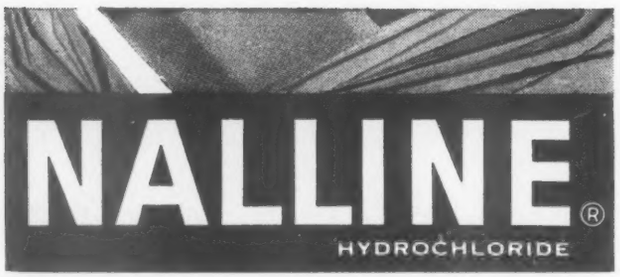

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References: 1. Case reports in the Pfizer Medical Department Files from fifty-three clinicians, and the following published reports: Shubin, H.: Antibiotic Med. & Clin. Therapy 4:174 (March) 1957. Carter, C. H., and Maley, M. C.: Antibiotics Annual 1956-1957, New York, Medical Encyclopedia, Inc., 1957, p. 51. Winton, S. S., and Chesrow, E.: Ibid., p. 55. LaCaille, R. A., and Prigot, A.: Ibid., p. 19.

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EDITORIAL

Whiplash Injury and Liability

SEMANTICS has come to traumatic surgery. The victim of an automobile accident who has no apparent evidence of injury has at least a "whiplash injury." It suggests how punishing the accident has been and it is sufficiently descriptive of the action to sound quite technical. In the mechanism of injury the back of the victim is the handle of the whip and the cervical spine is the lash. Impact in an automobile accident causes the patient's body to be jerked by the back of the seat. Inertia causes the unsupported head to fall violently backward in relation to the body. (Fig. 1.) Recoil from the impact then throws the unsupported head violently forward, completing the whiplash action. (Fig. 2.) In a minor collision this may cause only a mild sprain of the cervical vertebrae and possibly a strain of the muscles of the neck and shoulders, yet this mechanism may be a violent occurrence in a high speed

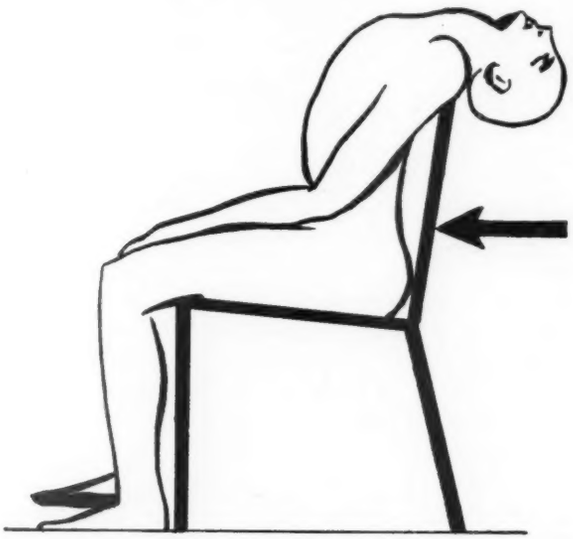

FIG. 1. The erect, unsupported head balanced free over the trunk, on impact (especially from behind), is thrown backward by its own inertia, maximated by the density and roundness of the skull. The anterior longitudinal ligament may tear and pull off fragments of the vertebrae.

FIG. 2. Recoil (the result of elasticity of the colliding body) affects first the trunk, which is in contact with the seat, and completes the pendulum swing of the head by throwing it forward onto the chest. Flexion of the cervical spine, blocked by the bodies of the vertebrae, occurs only at the junction of the seventh cervical and first thoracic vertebrae. The dorsal ligaments may rupture here and strain (or tear) nearby remaining structures.

accident. It is possible for the head of the victim to be found 100 feet down the road with the body still within the wrecked car. It has been noted in airplane accidents that while the torsos of victims were recovered, the heads were often never found.

The term whiplash in connection with injury to the neck is inaccurate; it suggests a mode of occurrence but not an exact location or severity of the injury. When a so-called whiplash injury has occurred, it is important to know whether there has been a minor or a major tear of ligaments, dislocation or fracture, or both. Since the injury can range from temporary indisposition to decapitation, the use of the all-inclusive term for such a wide disparity of severity is undesirable. A pole vault is not jumping part way to the moon, even if the jumper is getting away from the earth by a mighty effort. However, the word whiplash is highly suggestive, calculated to make a jury give a high award for a mild sprain of the neck. The increasing tendency toward litigation should not be stimulated by the misuse of words.

On the other hand, the modification of motor vehiele design with respect to possible injury to the neck should be given consideration. Possibly motor car design can incorporate a suitable neck support that the public will accept. This is a challenge to insurance companies and automobile manufacturers. Safety belts have been incorporated into cars and yet are probably not used. Most of them serve as a psychologic reminder that there are some advantages to driving more slowly. The average person resents overprotection, and will not accept a design that looks like wearing rubbers and a raincoat on a sunny day. However, the problem should not be confused by the lurid, loaded term, "whiplash injury to the neck."

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Postoperative Edema in Maxillofacial Surgery

PREVENTION AND TREATMENT WITH PROMETHAZINE

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ONE of the disturbing complications of maxillofacial surgery is occurrence, at the operative site, of edema which is part of the local reaction to traumatic insult to the tissues [*1,2*]. Such accumulations are composed basically of inflammatory exudate [*3*] and are accompanied with mechanical obstruction of blood and lymph channels [*4*]. It is presumed that trauma from any cause stimulates mast cells to release histamine, and that histamine causes capillary hyperemia, increased permeability and edema [*5*]. Thus after injury the tissues are distorted and distended with fluid, and the swelling may be aggravated by the surgical manipulation required in treatment. Consequently, precise alignment or accurate apposition of damaged parts may be rendered more difficult and the patient may suffer greater disfigurement during the recovery period.

The methods employed to prevent or relieve post-traumatic edema of the face have included a variety of physical and chemotherapeutic measures [*6*], with a diversity of results. Heretofore we have administered prophylactic injections of hyaluronidase* [*1,6–10*] before any procedure in which severe edema was anticipated.

* Hyaluronidase is available as wydase® (lyophilized and stabilized solution) from Wyeth, Inc., Philadelphia, Pa.

Prophylactic and therapeutic use of antihistamines also would seem logical since it is known that the clinical disorders most amenable to antihistaminic therapy are those characterized by pronounced exudation of fluids into the tissues. In the pharmacologic experiments of Weeks and Gunnar [*11*] the characteristic physiologic effects of histamine [*12*] injected into experimental animals were prevented by intravenous administration of antihistamine. Silverman [*13*], the first clinical investigator to use antihistamines parenterally before performance of intraoral operations, reported a tremendous reduction in the incidence and severity of concomitant traumatic swelling.

Promethazine Hydrochloride

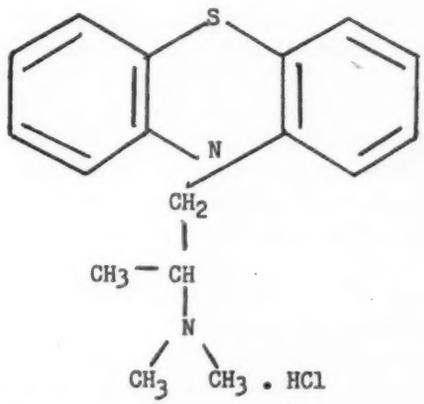

FIG. 1.

Promethazine (Fig. 1), a derivative of phenothiazine, possesses strong antihistaminic and atropine-like properties [*14*], and exerts pronounced sedative [*15*], antiemetic [*16*] and antiedema actions [*17*]. Extensively used in clinical medicine for several years in Europe, the compound is also widely administered in this country and Canada for treatment of allergies, and nausea and vomiting from various causes; recently the compound has been found advantageous for sedation in obstetrics [*18*] and various types of surgery [*2,15,19,20*]. Blinderman [*2*] reported that oral administration of promethazine to two groups of patients subjected to severe dental procedures prevented postoperative swelling of the face and other sequelae in almost all.

TABLE I
DIAGNOSES IN FORTY CASES REQUIRING MAXILLOFACIAL SURGERY

Diagnosis	No. of Cases
Nasal deformities (including saddle nose)	16
Fractures of jaw (mandible 11, maxilla 1)	12
Fractures of malar bones	5
Fractures of zygomatic arch	3
Chronic osteomyelitis of mandible	1
Prognathism	1
Depression of frontal bone	1
Enlargement of submaxillary lymph node	1
Total	40

PLAN OF INVESTIGATION

Promethazine* was administered preoperatively to a series of forty patients (twenty-seven males, thirteen females, with a median age of thirty years) requiring maxillofacial surgery. (Table 1.) These cases were specially selected because of the tendency toward edematous swelling that customarily complicates the procedures required (Table II), and because, since the presence of edema is obvious after these operations, the effect of medication could be readily determined. Postoperative nausea and vomiting, pain, bleeding, rate of healing and side reactions also were observed, and the sedative effect of the compound was evaluated.

* Phenergan® hydrochloride, promethazine hydrochloride, is available from Wyeth, Inc.

Dosage. Thirty-six patients (90 per cent) received promethazine orally in doses of 25 mg. the night before surgery, 25 mg. one hour prior to induction and 25 mg. each night thereafter in the postoperative period.

In four patients (10 per cent) admitted with severe facial trauma and prepared for immediate surgery, promethazine was administered intramuscularly in doses of 50 mg. one hour preoperatively, and similarly, every twelve hours for the first two postoperative days. Open reduction for a fractured mandible was performed in three of these patients, and a Caldwell-Luc approach for elevation of a zygoma in another. All operations in this group were performed under general anesthesia. Pressure dressings are customarily used in such mandibular and zygomatic operations.

TABLE II
MAXILLOFACIAL OPERATIONS IN WHICH PROMETHAZINE WAS USED TO PREVENT OR CONTROL TRAUMATIC EDEMA

Procedure	No. of Cases	Anesthesia	
		General	Local
Rhinoplasty	15	2	13
Open reduction of fractured mandible	11	7	4
Open reduction of fractured zygoma	4	..	4
Caldwell-Luc approach for reduction of fractured maxilla	4	3	1
Gillies' elevation of fractured zygomatic arch	1	..	1
Resection of symphysis of mandible	1	1	..
Sequestrectomy of mandible	1	1	..
Polyethylene implant (saddle nose, frontal bone)	2	1	1
Excision of submaxillary gland	1	1	..
Totals	40	16	24

All patients received either morphine sulfate (10 to 15 mg.) or meperidine (50 to 100 mg.) and scopolamine (0.0004 mg.) prior to surgery. Barbiturates were used preoperatively only in those cases in which local anesthesia was required, because of the need of additional depth of sedation. Secobarbital® was used in doses of 0.1 to 0.2 gm.

Antibiotics were administered for prophylaxis in all cases during the postoperative period.

RESULTS

The degree of edema experienced by any one patient after a given operation depends on so

many variables that the results of any type of medication administered for control of swelling cannot be accurately standardized. The effect must be evaluated solely on the basis of clinical impression; previous observations of many similar surgical cases were used as the sole comparative standard. Postoperative edema and also other common sequelae were graded as follows: none, 0; slight, 1+; moderate, 2+; severe, 3+.

TABLE III
INFLUENCE OF PROMETHAZINE MEDICATION ON POSTOPERATIVE SEQUELAE

Complication Observed	None 0 (No. of Cases)	Slight 1+ (No. of Cases)	Moderate 2+ (No. of Cases)	Severe 3+ (No. of Cases)
Edema (40 cases evaluated)	3	33	2	2
Nausea and vomiting (39 cases evaluated)	33	6 (5 general anesthesia, 1 local)	0	0
Pain (39 cases evaluated)	19	20	0	0
Bleeding (36 cases evaluated)	28	8	0	0

Edema. The over-all picture obtained in this series indicated that promethazine exerted a definite antiedema activity in the dosage used. (Table III.) The results, dramatic in some cases and less pronounced in others, compared favorably with the degree of control of edema previously obtained with local injection of hyaluronidase at the operative site. In earlier cases in which neither hyaluronidase nor promethazine was used, the majority of patients exhibited moderate to severe edema after operation.

In this series no edema developed in three patients (7 per cent). There was slight swelling in thirty-three cases (84 per cent), and a moderate degree in two (4.5 per cent). In only two patients (4.5 per cent) was the swelling severe, and in these two operations (open reduction of fractured mandible) the surgeon neglected to apply a postoperative pressure dressing, which was standard practice even before promethazine was introduced.

Nausea and Vomiting. Preoperative administration of promethazine significantly reduced the occurrence of postoperative nausea and vomiting. Thirty-nine patients were evaluated, of whom thirty-three had no nausea and six had only slight nausea and occasional vomiting. Of the latter, five had received general anesthesia and one local anesthesia. The general anesthetic agents used were intravenous sodium pentothal,® and nitrous oxide and oxygen administered by endotracheal tube.

Pre- and postoperative sedation was adequate in all but one patient, a sixteen year old boy, who, while undergoing a rhinoplasty, became extremely apprehensive, emotionally unstable and uncooperative. Supplementary medication was necessary to permit continuation of the operation.

The other patients slept well each night, and on arrival in the operating room were quiet and drowsy but cooperative.

The preoperative requirement for barbiturates was reduced in the patients operated upon under local anesthesia. We found that in most patients 25 mg. of promethazine were approximately equivalent in sedative effect to 0.1 gm. secobarbital. No postoperative barbiturates were used.

There was no reduction in the amount of anesthetic used beyond that obtained in any well sedated patient. In this series the patients reacted promptly and in a normal manner after termination of the operation.

Analgesics. Promethazine apparently exerts no analgesic effect, but through its sedative action does tend to minimize the patient's discomfort. Thirty-nine cases were evaluated for degree of postoperative pain. Nineteen patients did not complain of pain, and twenty reported minimal discomfort during the first twenty-four to forty-eight hours after surgery. It should be noted, however, that the surgical procedures carried out in this series are seldom followed with severe distress.

Bleeding. Of the thirty-six cases evaluated, only eight patients bled slightly, and these were individuals who had undergone rhinoplasty. The bleeding consisted of moderate oozing during the first twenty-four hours, which stopped spontaneously in each instance. Promethazine seemed to have no effect on either the presence or absence of bleeding.

Rate of Healing. All incisions healed by first intention. No deleterious effects were noted from use of promethazine.

No undesirable side effects were seen in this series of forty patients.

SUMMARY

A series of forty patients (68 per cent males) with a median age of thirty years received promethazine before and after maxillofacial surgery prone to produce postoperative edema. For 90 per cent the compound was administered orally in doses of 25 mg. the night before operation, one hour before induction and each night thereafter throughout the postoperative period. The remaining 10 per cent, admitted for immediate operation, received 50 mg. intramuscularly one hour prior to induction; the same dose was repeated by the same route every twelve hours for the first two postoperative days. Analgesic and amnesic medication and antibiotics were used as indicated.

The influence of the medication on the degree of postoperative edema after a given procedure depends on so many variables that the results of any such measures must be evaluated solely on the basis of clinical impression and comparison with previous observations of similar surgical patients for whom the agent was not used.

In earlier cases, treated by various methods, the majority of patients exhibited moderate to severe edema. The over-all picture in this series, however, indicated that promethazine exerted a definite anti-edema activity in the dosage used. The results were dramatic in some instances and less pronounced in others, but all compared favorably with the degree of control of edema previously obtained with local injection of hyaluronidase at the operative site. Seven per cent had no edema; in 84 per cent there was slight swelling, in 4.5 per cent there was a moderate degree of edema and in 4.5 per cent (who underwent open reduction of fractured mandible) swelling was severe.

Medication with promethazine significantly reduced the incidence of postoperative nausea and vomiting.

The compound apparently exerts no analgesic action but tends to minimize the patient's discomfort by its strong sedative activity, does not influence postoperative bleeding and has no adverse effect on rate of healing.

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The Role of Ascaris Lumbricoides in Intestinal Perforations

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ONE of the causes of spontaneous perforation of the intestinal tract listed by textbooks on surgery and pathology is the helminth Ascaris lumbricoides. This etiologic agent is often only mentioned, and the pathogenesis of such perforation is not discussed. I wish to present for analysis my findings regarding the role of the helminth A. lumbricoides during an outbreak of intestinal perforations due to paratyphoid fever. This outbreak occurred among the North Korean prisoners of war during the Korean conflict. This episode of 203 spontaneous perforations of the ileum due to Salmonella paratyphi has been previously summarized by the author [1].

Ascaris Lumbricoides. While man is the only known host of A. lumbricoides, lower animals harbor a number of closely related species. Infection is world-wide, but predominates where sanitary and climatic conditions favor its dissemination.

A. lumbricoides, or the roundworm of man, is a large, flesh-colored parasite of the small intestine. The females measure 20 cm. or more in length by 5 mm. in diameter, and the males 16 cm. by 3 mm. The eggs are underdeveloped when passed in the feces. In soil or water they become infective in about one week, and may survive despite adverse chemical conditions. Ingested in food, particularly raw vegetables or water, they hatch in the intestine. The embryos, however, do not develop directly into adults in this site, but gain access to the circulation where they are carried to the lungs and escape into the air spaces. Via the trachea, they reach the pharynx and are swallowed. Development of the ascaris occurs during migration and is completed in the small intestine, where egg-producing adults may be found about two and a half months after infection.

In man the adult A. lumbricoides is capable of causing (1) anemia, (2) inflammation of the intestinal wall, (3) intestinal obstruction, and (4) intestinal perforation. Although the first three conditions are fairly well recognized, the ability of the roundworm to perforate the intestinal wall has long been a topic of argumentative discussion. The basic issue of such discussion is whether or not the ascaris can perforate a healthy intestinal wall, and also whether it can pass through the enteric wall into the free peritoneal cavity without causing a visible opening in the bowel wall.

Schultze [2] in 1906 and Kaiserling [3] in 1922 both described an ascaris with its head buried in the intestinal wall as if in the process of burrowing through. Gruber [4], Glanzmann [5] and Peiper [6] each believe the ascaris can perforate a healthy intestinal wall. Gruber attributes this ability to the production of a toxin which necroses the intestinal wall. Henoch [7], Lelong [8] and others do not believe the ascaris can perforate a healthy intestinal wall, but believe some other factors must first weaken and ulcerate the bowel wall before the ascaris can pass into the free peritoneal cavity. During the Russo-Japanese War Silberberg [9] performed autopsies on those patients who had died of intestinal perforation, and found all to have typhus abdominalis. Again, however, due to the presence of the roundworm free in the peritoneal cavity, the question arose as to whether or not the roundworm had caused the weakened wall to perforate.

As yet there has been no feasible explanation of the finding of A. lumbricoides free in the

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peritoneal cavity at the time of celiotomy without any visible perforation of the intestinal tract.

Observations during the Korean Conflict. A series of spontaneous perforations of the ileum occurred during the Korean conflict among the North Korean prisoners of war. The initial perforations occurred in October, 1950. A total of 203 patients were surgically explored and the diagnoses of perforation of the ileum due to paratyphoid fever were confirmed. During the course of investigative study to determine the etiologic factor responsible for the intestinal perforations, the agent A. lumbricoides was considered by some as a possible cause during the early investigative period. This was understandable when one considers the frequency of its occurrence. The laboratory aspect of this study, which revealed the S. paratyphi organism as the primary cause, has been presented by Zimmerman et al. [*10*], and the clinical aspect by the author in previous articles.

In May, 1951, a Joint Dysentery Unit was established to study enteric infections among the North Korean prisoners of war. While the primary purpose of this survey was to obtain an estimate of the amebiasis problem, an additional finding was an 81.3 per cent incidence of the helminth A. lumbricoides in 1,404 cases.

In an analysis of eighty-five patients surgically explored with the operative diagnosis of spontaneous perforation of the small bowel due to paratyphoid fever, some interesting observations regarding A. lumbricoides were made. (Table I.)

In the subsequent discussion we will disregard the fifty-two cases in which no mention of the presence or absence of roundworm was made in the operative report, and will analyze only the remaining thirty-three cases.

TABLE I

LUMBRICOIDES—ABSENCE OR PRESENCE AND LOCATION AT TIME OF SURGICAL EXPLORATION

	No. of Patients
A. lumbricoides palpable within the lumen of the small bowel at surgical exploration	15
A. lumbricoides found alive and free in the peritoneal cavity at surgical exploration	8
Surgeon states "no roundworm palpable" at surgical exploration	10
No mention of A. lumbricoides as to presence or absence at surgical exploration	52

A. Lumbricoides and the Positive Roentgenologic Finding of Free Intraperitoneal Air. The first thought was an attempt to correlate the finding of free intraperitoneal subdiaphragmatic air on preoperative roentgenographic examination of the abdomen, and the later finding at surgery of the helminth A. lumbricoides. I wished to determine whether or not the roundworm increased the incidence of positive films for free subdiaphragmatic air merely by its presence within the small bowel lumen, and also whether this incidence was increased by the worm causing a larger or more sustained opening in the bowel wall in passing from the lumen into the free peritoneal cavity.

TABLE II

CORRELATION OF PREOPERATIVE ROENTGENOGRAMS OF ABDOMEN IN PATIENTS WITH PERFORATION OF ILEUM DUE TO S. PARATYPHI AS TO ABSENCE OR PRESENCE OF A. LUMBRICOIDES AT SURGICAL EXPLORATION

A. Lumbricoides	No. of Patients Positive for Free Air	No. of Patients Negative for Free Air	No. in Which X-rays Not Taken
Palpable intraluminally on surgical exploration	7	6	3
Free and alive in the peritoneal cavity on surgical exploration	1	3	4
None palpable on surgical exploration either intraluminally or free in the peritoneal cavity	2	3	5

An interpretation of Table II is that there is no demonstrated relationship between the findint of free intraperitoneal air and the presence or absence of the roundworm either intraluminally or free in the peritoneal cavity.

A. Lumbricoides and Splenic Enlargement. The second clinical investigation was an attempt to correlate the roundworm and splenic enlargement. In a previously reported series [*1*] of S. paratyphi infections I reported a 40.9 percentage of splenic enlargement on direct palpation at the time of surgical exploration. Since the infection rate with A. lumbricoides was so high, it was thought that there may have been

some relationship between splenic enlargement and the chronic helminth infection. The figures listed in Table III are based on direct splenic palpation at the time of surgical exploration.

Again in this small series of cases there appeared to be no relationship between splenic

TABLE III
RELATIONSHIP OF A. LUMBRICOIDES AND SIZE OF SPLEEN AT SURGICAL EXPLORATION

A. Lumbricoides	Normal Spleen	Enlarged Spleen	No Mention
Palpable intraluminally	6	6	3
Free and alive in peritoneal cavity	1	0	7
None palpable either intraluminally or intraperitoneally	4	4	2

enlargement and A. lumbricoides infection, for while 50 per cent of those harboring the roundworm revealed an enlarged spleen, a similar percentage was noted in those who were palpably free of intestinal worms.

A. Lumbricoides and Intestinal Perforation. This particular phase was divided into two aspects:

1. Can the A. lumbricoides perforate a healthy intestinal wall?

As seen in Table 1, the roundworm was found free and alive in the peritoneal cavity at the time of surgical exploration in eight patients. A definite fecal peritonitis was noted, and therefore careful perusal of the intestinal tract was made. The ileum was involved in an acute inflammatory process, and an ileal perforation was found in six of these patients. Now at this point, had the intestinal perforation simply been closed, the question would have been left unresolved; however, the ileum in these patients was resected and in all specimens mucosal ulcerations were found. The ulcerated areas varied in number from one to nine per resected specimen, and from minimal penetration to full perforation of the intestinal wall. Laboratory investigation revealed the etiologic agent responsible for the mucosal ulcerations and eventual perforation to be S. paratyphi, an enteric pathogen. The salmonella organism, not the helminth A. lumbricoides, was responsible for the intestinal ulceration and perforation.

2. Can the A. lumbricoides perforate the intestinal wall without leaving a visible opening?

This question is much more difficult to evaluate and reach a definite conclusion. Again referring back to Table 1 and the eight patients in whom the roundworm was found free and alive in the peritoneal cavity, only six of these eight patients had a visible perforation of the intestinal tract. The remaining two patients were explored very carefully in an attempt to find a point of exit, but none was found. In all these patients the ileum, as stated previously, was involved in an acute inflammatory process and definite fecal peritonitis was present. In the two patients in whom no visible perforations were found the operative treatment was as follows: The involved ileum was resected in one patient but no pathologic report was obtained on the resected ileum, while in the second patient only drainage of the peritoneal cavity was performed. In the latter patient a fecal fistula developed which later closed spontaneously. Therefore, on the basis of these two cases, one might agree with those who believe the roundworm has the ability to pass through the intestinal wall without causing a visible perforation. This conclusion, I believe, would be incorrect. I base this statement on another case history of a patient (H. K. H.)* who was explored with the preoperative diagnosis of generalized peritonitis secondary to a perforated viscus. Exploratory laparotomy revealed fecal peritonitis with the ileum involved in an acute inflammatory process. Gross evidence of small bowel spillage and peritoneal contamination was present, but careful examination of the bowel failed to reveal perforation. The involved segment of ileum, however, was resected, and the specimen revealed six transverse mucosal ulcerations; and although no perforation was visible grossly, the pathologist reported a perforation of the base of the largest mucosal ulceration. The point of perforation was sealed off by edema and plastic exudate, and was not visible at the time of exploration.

The fecal fistula which developed postoperatively in the former patient, who had only peritoneal drainage instituted, probably represents a reopening of the sealed perforation due

* This case has been included previously in another article [1] concerning this particular outbreak of perforations of the ileum.

to distention and increased intraluminal pressure postoperatively.

I believe that a perforation is always present, although at times it may be sealed off and not visible at the time of exploration.

CONCLUSION

An attempt is made to shed additional light on the helminth A. lumbricoides as a causative agent of intestinal perforation. It is my opinion that an enteric pathogen is always present in those apparent cases of roundworm perforation. The etiologic agent in the aforementioned cases was the S. paratyphi organism. The ascaris is simply a passenger within the intestinal lumen and escapes into the peritoneal cavity through a preformed perforation caused by another enteric pathogen.

I was also unable to find any relationship between the preoperative presence of free intraperitoneal air and the roundworm, or between the roundworm and the size of the spleen on direct palpation at the time of surgery.

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Primary Hodgkin's Disease of the Stomach

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ALTHOUGH primary Hodgkin's disease of the stomach was strongly suspected before operation in one case, in none of the thirty-six cases reported in the literature has the diagnosis been positively diagnosed prior to surgery. Neither the clinical history, the laboratory studies nor the gross appearance of the lesion at the operating table will establish a diagnosis. The condition might be suspected by the roentgenologist, but it is from the microscopic picture alone that the correct diagnosis must be ascertained.

Because the symptoms, the roentgenologic findings and the gross pathologic picture so closely resemble carcinoma of the stomach, this condition has been and could be considered incurable. Widespread glandular metastasis with a large ulcerating lesion of the lesser curvature even gives the appearance of an inoperable cancer. Such was the case in one of our patients (Case I), in whom only a gland was removed for biopsy fifteen years ago and who is alive and well after only deep x-ray therapy. The literature contains reports of patients surviving many years with only palliative treatment. Consequently, no gastric lesion should be considered hopeless until proved otherwise.

In the literature may be found reports of many cases of Hodgkin's disease in which the stomach was secondarily involved. The prognosis in these cases is no better than in metastatic lesions from carcinoma.

From the meager knowledge of the subject, it would seem that the ideal treatment of the primary type of the disease is gastric resection followed by deep x-ray therapy.

HISTORY

Hodgkin first described lesions in the stomach and duodenum as part of a generalized Hodgkin's disease in 1832. Schlagenhaufer reported the first case of primary Hodgkin's disease of the stomach in 1913. Steindl performed the first successful gastric resection for this condition in 1924.

As pointed out by Yarnis and Colp in 1943, the fact that pathologists have disagreed on the classification of tumors of lymphoid origin has resulted in considerable confusion in the nomenclature in papers dealing with this subject. One of the early papers to clarify this subject was published in 1942 by Warren and Lulenski and was titled "Primary, Solitary Lymphoid Tumors of the Gastrointestinal Tract."

In 1946 Brown and McHardy reported two cases of isolated Hodgkin's disease of the stomach and noted but twenty in the literature. Marshall reported eight more from the Lahey Clinic in 1950. He noted that one in every twenty-five cases of a series of 406 gastric malignancies was non-cancerous, there being nine lymphosarcomas, two reticulum cell sarcomas and four malignant lymphomas. Three additional cases were added by Bond and Pileggi, Berg and Sandick, making a total of thirty-six cases including the three reported in this paper, two of which have been previously reported.

SYMPTOMATOLOGY

As previously noted, there is nothing characteristic about the symptoms of this condition. In general, they resemble that of carcinoma of the stomach, with pain, loss of weight and strength, anorexia, nausea and, at times, vomiting. However, the following differences may be noted. The pain, which is often negligible in early malignancy of the stomach, may be rather severe in Hodgkin's disease, as in Case III, and is of much longer duration. By contrast, an abdominal mass is seldom palpated. The characteristic cachexia is absent, and the patient, in general, appears in better health. Anemia may be present but is less marked.

Bockus stated that a diagnosis of primary Hodgkin's disease of the stomach cannot be made except by histologic examination. He stated that a few of the patients in the reported cases had given a clinical history suggestive of an ulcer-like syndrome.

CASE REPORTS

CASE I. L. G., a twenty-two year old man, came to the Clinic on May 27, 1940, complaining of a sharp pain in the pit of the stomach of one week's duration. When half through eating a meal, he noticed a sharp pain. At other times he experienced a pain in the abdomen that was intermittent. This discomfort had occurred for three or four years but had been worse the past three months, requiring him to lie down at times because he became weak.

Physical examination was essentially negative and showed a well nourished young man. The blood pressure was 128/80; pulse, 74; and temperature, normal.

The hemoglobin was 16 gm. per cent; the red blood cell count, 4,800,000 per cu. mm.; and the white blood cell count, 8,950 per cu. mm. The urine was normal. The Kahn test was negative. The sedimentation rate (Westergren method) was 11 mm. per hour. Gastric analysis showed achylia. X-rays of the esophagus, stomach, gallbladder, small bowel, colon and kidneys were all normal.

The patient was given dilute hydrochloric acid with his meals and kept under medical observation. He showed no improvement. On February 7, 1941, another x-ray of the stomach showed a probable lesion in the middle third of the stomach near the greater curvature, probably a new growth.

On February 14th exploratory laparotomy was performed and revealed a large ulcerating lesion, 4½ by 2½ cm., present in the middle third of the stomach involving the greater curvature. There were many enlarged glands in the lesser peritoneal cavity around the pancreas. The spleen was moderately enlarged. No nodules were seen or felt in the liver. The growth in the stomach was considered resectable but, because of the numerous and widespread metastatic lesions, it was thought that resection would be of no benefit. A frozen section was reported to show a high grade malignancy.

However, a report on the fixed section by Dr. Henry Bunting (nationally recognized authority on the subject) showed gastric glands which were not well stained and which were somewhat shrunken. There was loss of normal architecture, fine fibrosis as well as adenitis, and endothelial proliferation, with giant cells of Hodgkin's disease type. He believed the diagnosis of Hodgkin's disease was justified.

The patient was then given a course of deep x-ray therapy with immediate improvement in his general condition. On August 22nd another x-ray showed only a minimal defect; otherwise the stomach was normal. On November 22nd there was no defect noted in the x-ray of the stomach, and the roentgenologist considered this to be in the category of amazing miracles.

The clinical improvement was in proportion. The patient's appetite was excellent, and within three months he gained 15 pounds. He was free of pain and was performing all his normal duties.

He was seen periodically during 1943, 1946, 1950 and 1951. There was a steady gain in weight and all x-rays of the stomach were normal. On August 2, 1956, he reported for a check-up and stated that he had been in excellent health since his last visit five years previously, and that he now weighed 194 pounds. He had experienced no pain but during the past year had noticed an occasional full feeling with gas. His general examination was negative, except for a hydrocele on the left side. A test meal disclosed hypochlorhydria in contrast to the original achylia noted fifteen years before on his admission. An x-ray of the stomach showed what appeared to be a small ulcer on the lesser curvature of the pars media which appeared to be a benign lesion. No other disorder was noted. The patient was told to return in five weeks for another x-ray of the stomach. The blood count was normal.

This patient appears to have survived the longest of any patient recorded in the literature.

CASE II. R. C., a fifty year old merchant, came to the Clinic on September 16, 1950, with the complaint of dull, aching, epigastric pain of four months' duration. The pain was not related to food intake and was never accompanied by nausea or vomiting. It had been associated with "indigestion," mild anorexia, and a weight loss of 10 pounds. The patient gave a history of chronic constipation but never any melena.

At fifteen he had had an operation for intes-

tinal obstruction and at twenty, repair of bilateral inguinal hernia and bowel resection. He said he had had rheumatic fever many years previously and was told he had a heart murmur.

Physical examination showed a well nourished, well developed, white man in no acute distress. The heart was enlarged to the left anterior axillary line. There was a diastolic murmur, grade 3, present at the base and a harsh systolic murmur over the entire precordium. The lungs were clear to auscultation and percussion. Except for several scars, the abdominal examination was negative. No enlargement of lymph nodes was detected. The blood pressure was 128/62; pulse, 84; and temperature, normal.

On October 3rd blood tests showed: hemoglobin, 12.5 gm. per cent; red blood cell count, 4,160,000 per cu. mm.; and white blood cell count, 9,000 per cu. mm. The Kahn test was negative; the icterus index and urinalysis were normal. An x-ray examination after barium meal revealed a large ulcer on both the lesser and greater curvatures of the stomach.

On October 17th he was admitted to the hospital because of a low blood count and a history of gastrointestinal bleeding with both hematemesis and melena. His hemoglobin was 8.6 gm. per cent and red blood cell count, 2,490,000 per cu. mm. His fasting gastric contents had 22 units of free acid. After repeated bouts of bleeding and transfusions he was prepared for laparotomy, which was performed on November 22nd.

There was a mass about 3 by 1 inches on the greater curvature of the stomach; on the lesser curvature there was a smaller mass which was thought to be inflammatory. The stomach was opened and an ulcer was found in each of the masses. Small, firm lymph nodes were present in both the lesser and greater omentum. Partial gastric resection was performed with gastrojejunostomy of the Hofmeister technic. Postoperative recovery was uneventful, and the patient received follow-up, deep x-ray therapy.

The pathologic diagnosis was malignant lymphoma of the stomach. From the histologic appearance of the lymph nodes it was classified as Hodgkin's disease by our pathologist, Dr. Etheldred L. Schafer. Grossly, the lesion of the greater curvature was circular and measured 6 by 6 cm. That on the lesser curvature measured 3.5 by 3.5 cm. Both lesions had scalloped, raised, firm margins and flat granular bases. On section, the wall was thickened up to 1.4 cm.; this thickness was caused principally by an increase of pale yellowish gray tissue in the mucosa and submucosa. The lymph nodes in the lesser curvature were pale gray and measured up to 0.8 cm. in diameter.

Periodic check-ups, the latest on August 28, 1956, have shown the patient to be in excellent health.

CASE III. R. M., a fifty-eight year old farmer, entered the Clinic first on July 19, 1951, because he thought he had an inguinal hernia on the left side. He also complained of belching, abdominal distress and a 45 pound weight loss during the past three years.

Until 1948 he had enjoyed good health. At that time he noticed epigastric distress following meals, associated with belching and occasional vomiting (never hematemesis). The vomiting usually occurred after breakfast and relieved the distress. Since these symptoms always followed a meal, the patient decreased his food intake and became almost symptom-free.

In June, 1951, an intermittent aching pain developed in his left inguinal region, which he believed was caused by a hernia.

He never had actual pain or loss of appetite, and no food intolerance, melena or change in bowel habits.

Despite a good appetite, his weight steadily decreased from 175 pounds in 1948 to 130 pounds just prior to surgery, a loss of 45 pounds in three years.

The patient appeared to be a fairly well nourished white man with evidence of loss of weight. Abdominal and rectal examinations were negative. The external inguinal ring on the left was enlarged, but no hernia protruded. The lymph nodes in the cervical, axillary and inguinal regions were not enlarged. The blood pressure was 117/70, the pulse was 72, and the temperature was normal.

Blood tests showed: hemoglobin, 12.5 gm. per cent; red blood cell count, 4,000,000 per cu. mm., and white blood cell count, 7,300 per cu. mm., with the differential within normal limits. Except for a few pus cells and a trace of albumin, urinalysis showed normal results. The sedimentation rate (Westergren method) was 6 mm. per hour. The Kahn test was negative. The gallbladder contained several stones

and its function was slightly impaired. X-ray examination following a barium meal showed an irregular filling defect of the cardia on the lesser curvature of the stomach.

The diagnosis was carcinoma of the cardia of the stomach, and the patient was operated upon on September 4th. Operation revealed an extensive tumor of the greater portion of the stomach and enlarged lymph nodes in the greater omentum and para-aortic region. The liver was not involved. High, subtotal gastrectomy was performed with an anterior gastrojejunostomy of the Hofmeister type. After an uneventful recovery the patient was discharged on the thirteenth postoperative day. He received follow-up, deep x-ray therapy (4,200 r over a period of two weeks).

The pathologic diagnosis was Hodgkin's disease of the stomach and accompanying lymph nodes.

In her description of the specimen, grossly, Dr. Schafer said the serosa of the stomach was bluish gray, dull, opaque and finely granular over the anterior surface. Except for the pylorus, the wall was diffusely thickened up to 1.8 cm. and was firmer than normal. The mucosa was reddish brown, finely granular, with firm and non-compressible rugal folds. The mucosa lacked the usual movability due to a fixed submucosa. The fat of the lesser curvature contained a number of small, firm, pale gray lymph nodes.

Microscopically, the gastric lesion was characteristic of a malignant lymphoma with a rare Sternberg-Reed cell. These latter cells were more numerous in the lymph nodes and confirmed the impression of Hodgkin's disease.

The patient made a good postoperative recovery except for difficulty with meals and failure to gain weight, which at first was thought to be on the basis of his small gastric remnant. He was doing fairly well until he was admitted to the hospital after a week of pain suggestive of biliary colic. In view of the known gallstones, cholecystectomy was performed on December 29th. Exploration at that time did not reveal any recurrence of his malignant lymphoma. He made a satisfactory recovery and was sent home on a diet aimed at increasing his weight through multiple small meals. Because of hypoproteinemia, proteins were increased.

He gained 26 pounds in weight by March, 1952. Upon examination at this time there was no cervical adenopathy, no definite masses were felt in the abdomen, and the spleen and liver were not palpable. There was some ascites and pitting ankle edema, grade 3 plus. The heart was within normal limits.

He was given mercuhydrin,® ascorbic acid, ammonium chloride, banthine,® and metropine.®

On May 12, 1952, he looked pale and had obviously lost weight. His abdomen was distended, both with distended bowel and a considerable quantity of free fluid. There was a question of a mass in the epigastrium. No enlarged nodes were noted in the neck or groin. Rectal examination was negative.

On May 15th abdominal paracentesis was performed with the removal of 3,600 cc. of fluid.

Microscopic description of the abdominal fluid showed large numbers of cells which were relatively small with round nuclei that took up most of the cell volume. Scattered among these cells were slightly larger cells which had oval or faintly lobated nuclei that took a slightly fainter stain. These had prominent nucleoli and a somewhat uneven chromatin distribution. Some of the prominent nucleoli contained two or three such nuclei; these were correspondingly larger in size. Diagnosis was "atypical lymphocytes consistent with previous diagnosis of malignant lymphoma—Hodgkin's disease."

Paracentesis was done again on June 2nd with the removal of 3,900 cc. of fluid.

From June 3rd to June 16th ten deep x-ray treatments were given to the abdomen (2,170 r). He failed to respond well to x-ray therapy, and was given a trial of triethylene melamine, three 5 mg. tablets on successive days. He died on August 3rd.

SUMMARY

1. Primary Hodgkin's disease of the stomach is a rare condition; approximately thirty-six cases have been reported in the American literature.

2. Neither the clinical history, laboratory studies nor the gross appearance of the lesion will establish the diagnosis.

3. The diagnosis must be made by histologic examination.

4. The clinical symptoms, in general, resemble those of cancer of the stomach.

5. The following points of difference may be noted: the pain is of longer duration and

greater intensity; cachexia is absent; and an abdominal mass is seldom noted.

6. The treatment is gastric resection followed by deep x-ray therapy.

7. Three cases are reported. Two patients are living and well; one has survived fifteen years and one six years. One patient died a year after surgery; in this case the disease involved the cardia of the stomach.

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Primary Lymphosarcomas of the Stomach

REPORT OF SEVEN CASES

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PRIMARY lymphosarcomas of the stomach are relatively rare neoplasms. Taylor [1], in 1939, collected 500 cases from the literature. Crile, Hazard and Allen [2] saw only nineteen cases at the Cleveland Clinic between 1935 and 1950. Marshall and Meissner [3], in a series of 1,172 operations for malignant tumors of the stomach at the Lahey Clinic from the years 1929 to 1949, found forty-one sarcomas. Of the forty-one sarcomas, there were nine leiomyosarcomas, ten cases of Hodgkin's disease, six reticulum cell sarcomas and four unclassified malignant lymphomas. Twelve of the forty-one cases were primary lymphosarcomas. The ratio of sarcoma to carcinoma was 1:28, or 3.5 per cent. Yarnis and Colp [4] found eight cases of lymphosarcoma in a series of 250 neoplasms of the stomach over a six-year period, an incidence of 3.2 per cent. Dockerty [5] states that in the primary lymphoblastomas of the gastrointestinal tract, approximately 50 per cent will be in the stomach, 20 per cent will be in the small intestine, 20 per cent in the cecum, and 10 per cent will be in the remainder of the colon. The incidence of lymphoid tumors as reported in the literature varies from 0.0 to 4 per cent of all gastric malignancies.

The malignant lymphomas, including Hodgkin's disease, reticulum cell sarcoma, giant follicular lymphoma and lymphocytic leukemias, are generalized systemic diseases. In lymphosarcomas, we must recognize both a generalized and localized primary type. The localized variety of lymphosarcoma is usually found in the gastrointestinal tract, particularly in the stomach and small intestine. We believe there are no microscopic criteria by which one can tell whether a lymphosarcoma arises primarily in the stomach or whether the gastric involvement is part of a generalized process. This distinction is largely one of exclusion.

This report concerns those cases of lymphosarcomas which, as far as we were able to ascertain, were initially limited to the stomach and were not part of a generalized disseminated process. When such a localized lymphosarcoma spreads to adjacent lymph nodes and organs, the question arises as to whether this represents metastasis or a multicentric origin of the neoplasm. Willis [6] states, "Much ink was formerly spilt over the question whether the extension of lymphosarcomas to multiple groups of glands and to other tissues was due to metastasis by transfer of cells or to multicentric or diffuse autochthonous origin. Microscopical study shows beyond all doubt that both processes occur. Abundant evidence for metastasis is afforded by the frequent finding of lymphosarcomatous invasion of veins and lymphatics, by the frequent colonization of lungs, heart, kidneys, skin or other organs histogenetically unrelated to the lymphoid tissues, the occurrence in these organs of discrete well-circumscribed obviously metastatic growths as well as diffuse infiltrations, and above all by the development of leukaemia. What is leukaemia but a circulating metastasis, and what are leukaemic infiltrations but the colonial descendants of the transported malignant cells? To attempt to explain all the disseminated lesions of lymphosarcomatosis or leukaemia by widespread autochthonous origin is to be blinded to the obvious by a pet hypothesis."

From November, 1942 to February, 1956, seven cases of primary lymphosarcomas of the stomach were treated at Touro Infirmary. Dur-

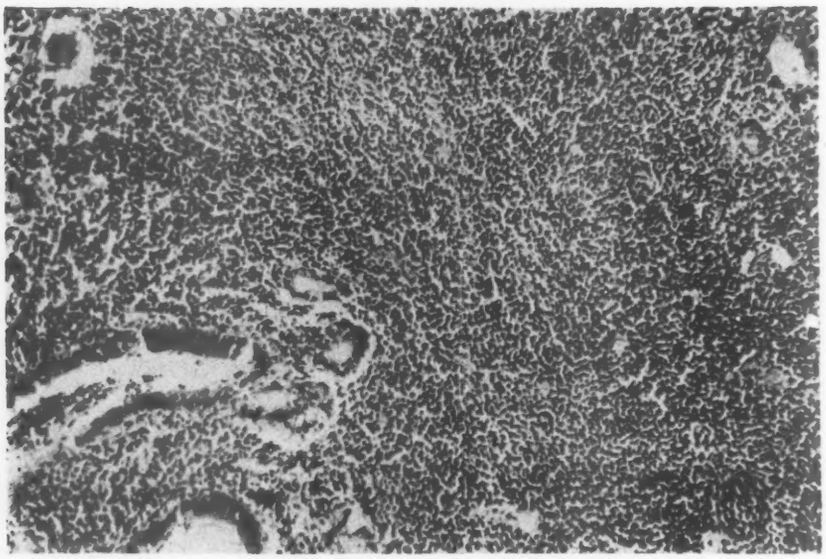

FIG. 1. Case II. Photomicrograph of stomach showing diffuse involvement of gastric wall by small lymphoid cells.

ing this same period 328 operations were performed for carcinoma of the stomach, giving an incidence of lymphosarcoma comprising 2.1 per cent. Lymphosarcomas comprise approximately 40 per cent of gastric sarcomas according to Bell [7] and Palmer [8].

CASE REPORTS

CASE I. This forty-eight year old white man (Hosp. No. S-42-3127) was admitted on November 29, 1942, complaining of pain in his stomach of two months' duration. Anorexia was present and there had been a 20 pound weight loss. Physical examination revealed no abnormalities except for slight tenderness and rigidity in the epigastrium. Laboratory work-up was non-contributory except for positive occult blood in stool. X-ray studies revealed a replacement of the normal gastric folds by extremely coarse, irregular folds of mucosa suggestive of a polyposis or infiltration of the mucosa by a lymphoma. On December 8th subtotal gastrectomy was performed. A large ulcer, 10 cm. in diameter, was situated on the greater curvature with induration of the surrounding walls. Histologic studies revealed a lymphosarcoma of the lymphoblastic type. The patient made an uneventful recovery and was discharged on January 2, 1943. There is no follow-up available on this patient.

CASE II. This fifty year old white woman (Hosp. No. S-50-3929) was admitted on August 28, 1950, with a nine-month history of epigastric pain two to four hours after meals. There was moderate tenderness in the left upper quadrant of the abdomen. No masses were felt. White blood count was 13,300 per cu. mm. with 83 per cent neutrophils. Hemoglobin was 11.7 gm. per cent. A gastrointestinal x-ray study revealed a marked coarsening of the rugal folds in the pars media and upper portion of the stomach. The lower portion of the pars media, 5 cm. proximal to the pylorus, showed numerous large polypoid defects distorting and replacing the rugal pattern. A fleck of barium was constantly seen in the central portion of the involved area on the posterior wall, suggestive of a shallow ulceration. There was no retention in six hours. On September 2nd subtotal gastrectomy was performed. The lesion appeared limited to the stomach at the time of surgery. The stomach showed an elevated, roughly circumscribed tumor mass measuring 4.5 by 5 cm. and located 4 cm. from the pylorus on the greater curvature. Histologically the lesion was a lymphosarcoma of the lymphocytic type. (Fig. 1.) The regional nodes in the omentum were involved. The patient was discharged as improved on September 10, 1950. She did fairly well until eight months following surgery when she died. Autopsy was not performed.

CASE III. A forty-five year old white man (Hosp. No. S-53-1233) was admitted on March

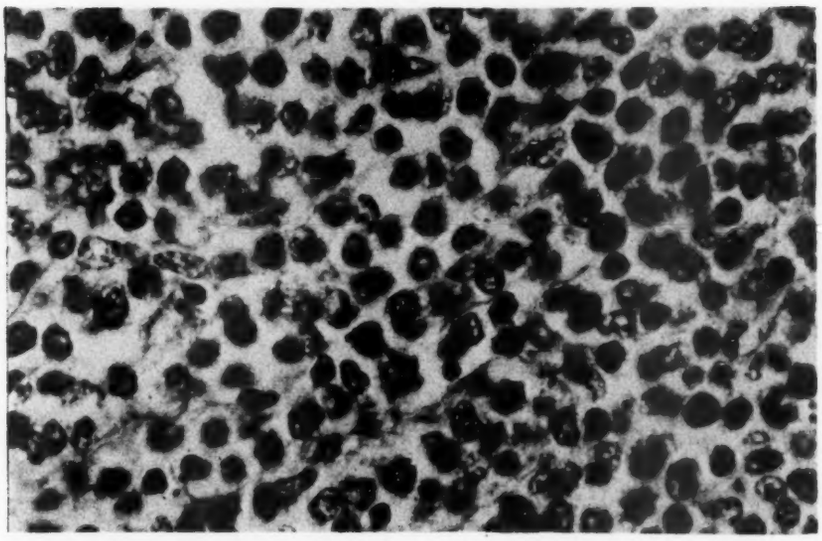

FIG. 2. Case III. Photomicrograph showing large immature lymphocytes as seen in a lymphoblastic lymphoma.

15, 1953, complaining of pain in the left upper quadrant of the abdomen and the epigastrium of seven to eight months' duration, which was relieved by food on most occasions. A gastrointestinal x-ray study done elsewhere revealed a large prepyloric ulcer. There was no appreciable weight loss or anorexia. Positive findings on admission were limited to tenderness and voluntary muscle guarding in the epigastrium and left upper quadrant of the abdomen. Laboratory studies were non-contributory. Subtotal gastric resection was performed on March 16, 1953. The omentum was removed with the greater portion of the stomach, and continuity was re-established by anterior gastroenterostomy. The stomach showed a large ulcer involving almost the entire mucosa of the resected stomach. The ulcer measured 9 by 6 cm. The base was hard and granular. The lesion did not appear to involve the serosa at any point. Numerous lymph nodes were dissected from the attached omentum. The microscopic findings were malignant lymphoma of lymphoblastic type with benign regional lymph nodes. (Fig. 2.) The patient was discharged on March 30, 1953. On May 23, 1953, three years and two months after the operation the patient was living and well, and working daily.

CASE IV. This sixty-seven year old man (Hosp. No. S-53-2389) was admitted on May 14, 1953, with a history of melena and hematemesis of 6 days' duration. There had been a history of a tarry stool two weeks prior to the aforementioned episode. There had been no associated abdominal pain or weight loss. A gastrointestinal x-ray study revealed a large irregular defect involving the proximal two-thirds of the greater curvature of the stomach. (Fig. 3.) Physical examination revealed a well developed, well nourished, white man with moderate pallor. There was slight tenderness in the right upper quadrant of the abdomen and the epigastrium. Physical examination was otherwise within normal limits. Hemoglobin was 11 gm. per cent and hematocrit, 34; the remainder of the laboratory findings were non-contributory. On May 15th total gastrectomy and splenectomy were performed. The stomach revealed several polypoid tumor masses projecting from the mucosal surface in the proximal two-thirds of the stomach, the largest measuring 11 cm. in diameter. (Fig. 4.) The regional lymph nodes were not involved, and examination of the spleen revealed no abnormalities. Microscopically the tumor was a lymphosarcoma of lymphocytic type. The patient was discharged on June 3, 1953. He did fairly well for a short time, but died at home nine months after surgery.

CASE V. This sixty-eight year old white man (Hosp. No. S-53-3987) was admitted on July 29, 1953, with a chief complaint of a "mass in his stomach." There was a long history of epigastric distress extending over two years. He had noted a swelling in his abdomen six weeks prior to admission. For the past two

FIG. 3. Case IV. Roentgenogram showing large defect involving proximal two-thirds of greater curvature of stomach.

years he had noted tarry stools and intolerance for fatty foods. He had recently had frequent episodes of vomiting. Physical examination revealed an epigastric mass approximately 8 by 12 cm. which was firm and non-tender. Initial laboratory work revealed a hemoglobin of 9.7 gm. per cent and a red blood count of 3,160,000 per cu. mm. White blood count was 9,900 per cu. mm. with a normal differential. A gastrointestinal x-ray study done prior to admission to the hospital revealed findings consistent with a gastric malignancy. On August 1st subtotal gastrectomy was performed with excision of the greater part of the omentum along with a portion of the duodenum, pancreas, spleen and transverse colon. The stomach showed a thickening of the distal half with ulceration over an area measuring 17 by 10 cm. The regional lymph nodes were moderately enlarged. Microscopic examination revealed lymphosarcoma of lymphoblastic type. The regional nodes and remaining organs were not involved. The patient ran a stormy postoperative course and died on the fifth postoperative day. Autopsy revealed no evidence of residual lymphoma.

CASE VI. This fifty-one year old white man (Hosp. No. S-53-6094 and S-53-6320) was admitted on November 26, 1953, complaining of abdominal pain, nausea and vomiting of six months' duration. The pain was located in the epigastrium, would occur before meals and was relieved partially or completely with food intakes. A gastrointestinal x-ray study revealed a defect on the lesser curvature of the stomach near the pylorus that was consistent with a gastric ulcer. Initial laboratory work revealed a hemoglobin of 14.7 gm. per cent. Leukocyte count was 12,300 per cu. mm. with a normal differential. Urinalysis was normal as were blood sugar and blood non-protein nitrogen tests.

On November 27th subtotal gastrectomy

FIG. 4. Case IV. Resected stomach showing large polypoid tumor masses.

and splenectomy were performed. The stomach showed an area of induration and thickening 6 cm. in diameter located 2.5 cm. proximal to the pylorus on the lesser curvature. The overlying mucosa was intact. The rugae region of the lesion were flattened and in some areas completely absent. The lesion was ill-defined and appeared limited largely to the mucosa and inner gastric wall. The serosa was not involved. Microscopically the lesion was a lymphosarcoma of the lymphocytic type. The regional nodes and spleen revealed no evidence of involvement. On December 12th the remainder of the stomach was removed and esophagojejunostomy was performed. The remaining cardiac portion of the stomach revealed a lymphocytic infiltration that was believed to be due to the recent surgery rather than residual lymphosarcoma. The immediate postoperative course was uneventful. The patient experienced distressing gastrointestinal symptoms and required psychiatric care for a mental depression. He had an incomplete course of postoperative x-ray therapy. He is living two and a half years following operation.

CASE VII. This sixty-five year old white man (Hosp. No. S-56-853) was admitted on February 15, 1956. He was well until approximately three months previous to admission when he noted some epigastric distress at intervals throughout the day. This apparently had no relation to food. He rapidly lost 10 pounds. Eight days prior to admission a watery diarrhea developed. Physical examination revealed epigastric tenderness but no other abdominal finding. The examination was otherwise within normal limits except for a systolic cardiac murmur. Laboratory examination showed a hemoglobin of 7.2 gm. per cent, hematocrit was 27 mm. and white blood count was 8,500 per cu. mm. with a normal differential. The smear was interpreted as a hypochromic anemia. A gastrointestinal study showed a large filling defect on the posterior wall of the proximal end of the stomach on the lesser curvature. The lesion had the appearance of a fungating and infiltrating mass involving the stomach wall. The remaining gastric rugal pattern appeared normal. The impression was a large gastric carcinoma. On February 22nd subtotal gastric resection and splenectomy were performed.

The resected stomach showed a large polypoid hemorrhagic tumor mass showing superficial ulceration. (Fig. 5.) The lesion measured 5 by 4.5 cm. and was located on the lesser curvature projecting into the lumen for a distance of 1.7 cm. The lesion appeared to involve only the mucosa as it pulled away easily from the underlying muscularis. The spleen revealed nothing of note. Several lymph nodes were identified. Microscopically the tumor was a polypoid lymphosarcoma of the lymphocytic type. The lymph nodes were benign and the spleen was not involved. The patient made an uneventful recovery and was given postopera-

FIG. 5. Case VII. Resected stomach showing large polypoid hemorrhagic tumor.

tive x-ray therapy. When last seen he had no evidence of any recurrence.

COMMENTS

The average age of the patients in this series was fifty-six years, the youngest being forty-eight and the oldest, sixty-eight. Marshall and Meissner [3], in a review of forty-one cases of sarcomas of the stomach, found fifty-three years as the average age. It is usually considered that sarcomas arise in a younger age group than carcinomas. However, any difference in age between patients with sarcomas of the stomach and carcinomas are hardly enough to be of value in the differential diagnosis of these lesions. The sex ratio was six males to one female. The sex ratio from the literature averages from 1.5 to 2.0 males to 1.0 females. As in carcinomas of the stomach, males are more prone to sarcomas of the stomach than females.

The presenting symptomatology in this series was usually epigastric pain, anorexia and indigestion. Epigastric pain is a prominent early symptom of sarcoma of the stomach. The location of the tumor in proximity to the submucosal plexus of nerves and their early infiltration in the muscle layers of the stomach may account for the early pain. One patient complained of an abdominal tumor mass while another showed melena and gastric hemorrhage.

In this series the diagnosis of lymphosarcoma was suspected in four of the seven cases. While it is true that the greater majority of sarcomas of the stomach are not diagnosed preoperatively, any of the following radiologic findings should give consideration in the differential diagnosis of a gastric lesion: (1) a filling defect with smooth margins; (2) a localized type of tumor with smooth and round margins; (3) a diffuse involvement of the stomach simulating linitis plastica; (4) thick mucosal folds, as seen on relief films; (5) a palpable tumor, especially in a younger age group; (6) multiple ulcers or polypoid tumors. The difficulty of radiologic diagnosis of lymphosarcomas of the stomach arises from the fact that these tumors may vary from large polypoid tumors to solitary ulcers, ulcers with diffuse involvement of the gastric wall and giant mucosal infiltration without ulceration, giving a resemblance to hypertrophic gastritis. Three of our patients showed solitary ulcers. A polypoid tumor was found in two cases. Two cases showed a diffuse involvement of the gastric wall simulating linitis plastica. A combination of this diffuse pattern with a large ulcer and polypoid tumor was found in one case. Most of the lesions involved the lesser curvature of the stomach. The pylorus was not involved in any of the seven cases. Lymphosarcomas usually do not involve the pylorus of the stomach. There is nothing characteristic about the gross lesion to separate it definitely anatomically or radiographically from epithelial neoplasms.

Lymphosarcomas can be classified cytologically into lymphocytic and lymphoblastic

types depending upon whether the predominating cell is a small, relatively mature lymphocyte or a larger, more immature lymphoblast. At times the distinction between a large cell lymphosarcoma and a reticulum cell sarcoma is arbitrary and depends upon the classification used by the pathologist. Lymphoid follicles may be a prominent feature in the better differentiated tumors. The lymphocytic lymphosarcomas are, as a rule, slower growing neoplasms than the lymphoblastic types. In our series three were of the lymphoblastic type and four were of the lymphocytic variety.

Follow-up studies were available in six of the seven cases. Only one patient has survived more than three years following surgery. Another was living two years postoperatively and a third, five months after surgery. The prognosis of lymphosarcomas of the stomach is considered more favorable as compared with gastric carcinomas. Marshall and Meissner [3] report a five-year postoperative survival rate of 33 per cent following total gastrectomies and 42 per cent following partial gastrectomies of lymphoid tumors of the stomach excluding Hodgkin's disease. Thorbjarnarson, Beal and Pearce [9], in a series of thirty-two patients with primary malignant gastric lymphomas including lymphosarcomas, reticulum cell sarcomas and Hodgkin's disease, recently reported 53 per cent five-year postoperative survival in all patients who survived curative operative surgery.

The treatment of choice of gastric lymphosarcoma is radical surgery followed by postoperative radiation. Enlargement of the regional lymph nodes in these cases should not be a contraindication to radical surgery as these nodes usually prove to represent reactive hyperplasia rather than neoplastic involvement. Only one of our seven patients proved to have regional lymph node involvement at the time of surgery.

SUMMARY

Seven cases of primary lymphosarcoma of the stomach were encountered at Touro Infirmary over a fourteen-year period, as compared to 328 cases of carcinoma during this same period. The average age was fifty-six years. The presenting symptomatology was usually epigastric pain. A preoperative diagnosis of lymphosarcoma of the stomach is usually not possible. However, radiologic findings were suggestive of the diagnosis in four of the seven cases. The gross and microscopic findings are discussed. The treatment of choice is radical surgery followed by postoperative radiation. The prognosis of lymphosarcomas of the stomach is considered more favorable than gastric carcinomas.

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The Diagnosis and Management of Acute Pancreatitis

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PANCREATITIS is being recognized as a cause of acute abdominal pain with increasing frequency, but the variety of symptom complexes and the difficulty in physical, radiologic and chemical interpretations continue to result in diagnostic inaccuracies. The importance of the recognition of acute pancreatitis cannot be overemphasized as improving mortality rates have followed the early diagnosis and the adoption of therapeutic measures based on increasingly sound physiologic concepts.

For this reason a study has been undertaken to determine the diagnostic aids utilized, the therapeutic measures advocated and the results of treatment during the years 1948 to 1955 at the Grady Memorial Hospital, a hospital devoted to the care of patients of the lower income group.

This series includes all patients admitted to the hospital between the years 1948 to 1955 in whom the diagnosis of acute pancreatitis was made by one or more of the following means: (1) a significant elevation of the serum amylase concentration in conjunction with signs and symptoms compatible with acute pancreatitis, (2) operative findings, and/or (3) necropsy. During the initial five-year period the diagnosis was made in forty-two patients and during the three-year period, 1953 to 1955 inclusive, in forty-seven patients.

DIAGNOSIS

The symptoms in this series of patients varied from mild epigastric pain to attacks of acute excruciating abdominal pain with profound peripheral vascular collapse. The physical findings were equally variable. The initial clinical findings resulted in a wide variety of considerations as to the correct diagnosis, and the dilemma was solved only after an elevated serum amylase concentration was found or operation undertaken.

The most universal symptom, abdominal pain, was present in every conscious patient. This pain was usually constant in nature and located in the epigastrium. No area of the abdomen was excluded from being the site of primary localization and several areas of the abdomen were often involved at the same time. The characteristic complex of epigastric pain radiating through to the back was frequently seen, but of more importance was the wide variance of both severity and localization. The retroperitoneal location and the bilateral sympathetic nerve supply to the pancreas understandably account for the difficulty in clinical localization of pain.

Nausea and vomiting were encountered in eighty-one patients, and other symptoms ran the gamut of those commonly observed in other intestinal diseases, including diarrhea, constipation, melena, abdominal distention, chills, fever and dyspnea.

The admission temperature was seldom elevated above 102°F. and was above 100°F. in only one-third of the patients. It seemed significant that the temperature was normal or subnormal on admission in most instances, but following admission usually rose to above 100°F., remaining there for approximately forty-eight to ninety-six hours, then dropping toward normal. A pulse rate of over 100 was encountered in approximately half the patients, but usually fell upon the institution of effective therapy.

The most characteristic physical finding was epigastric tenderness which was present in eighty-seven of the eighty-nine patients. Muscular rigidity occurred in only fifty-six patients.

Radiographic findings in the abdominal flat plate, although never specifically diagnostic of acute pancreatitis, often provided corroborative evidence. A positive diagnosis of pancreatitis was suggested by radiologic findings in fifteen patients, the diagnosis being considered on the basis of a sentinel loop of jejunum in the left upper quadrant in most instances. Displacement of the stomach, fluid in the left pleural space, calcification of the pancreas and an enlargement of the duodenal loop were only rarely seen. The value of radiographic studies in ruling out the presence of other intra-abdominal diseases was of even greater importance.

The single, most reliable diagnostic criteria was the serum amylase concentration. The serum amylase concentration was elevated in sixty-nine of seventy-nine patients in whom the determination was performed, and in only two instances was the level normal in the presence of pancreatitis, provided the serum had been drawn within forty-eight hours of the onset of the acute illness. In eight other patients, however, in whom the serum was drawn later than forty-eight hours after the onset of the acute attack, negative results were obtained in spite of the presence of acute pancreatitis. In these patients, and in the ten patients on whom the test was not performed, the diagnosis was made either at exploratory laparotomy or at necropsy.

While determination of the serum amylase concentration was the most accurate method of diagnosing acute pancreatitis, the frequency of false negative results is apparent. It is also unfortunately true that the amylase level may be significantly elevated in other intra-abdominal diseases which clinically simulate acute pancreatitis. In 12 per cent of the patients with perforated peptic ulcers observed in this hospital during the past year, an elevated serum amylase concentration has been present. In each patient with a perforated ulcer other positive diagnostic features have permitted establishment of the correct diagnosis. The frequency of an elevated amylase concentration in patients with acute cholecystitis [*1,2*] or other acute pathologic conditions within the abdomen may also be a source of considerable confusion.

Although infrequently used, the determination of the amylase concentration of peritoneal fluid may be a valuable test in the difficult diagnostic problem. This test was positive with an amylase activity of over 1,500 Somogyi units in four of five patients with acute pancreatitis.* In the one instance of a false negative result, the patient died after five days of prolonged shock. The amylase concentration of this patient's peritoneal fluid had been 192 units in spite of an overwhelming necrosis of the pancreas. When utilizing the peritoneal aspiration for diagnosis, it must be recalled that in any instance in which there is flow of the intraluminal contents of the upper bowel into the peritoneal cavity, the peritoneal amylase may be considerably elevated. When measured, the amylase concentration of the peritoneal fluid was elevated above 400 units in 50 per cent of the patients with perforated peptic ulcers observed in this institution, and above 1,500 units in 10 per cent. Once again, in these instances other diagnostic measures were of value in establishing the correct diagnosis.

Low serum calcium levels were present at various times after the onset of the acute illness in one-fourth of the patients on whom the test was performed. Hyperglycemia was noted in one-third of the patients studied. Whether the hyperglycemia represented a simple adrenocortical response to stress or was indicative of insufficient insulin production due to injury of the islet cells cannot be stated.

From this review of history, physical findings and enzymatic studies, it is readily apparent that in many patients pancreatitis is difficult to diagnose. Once pancreatitis is suggested by either history, physical examination or physician's suspicion, a serum amylase and possibly a peritoneal amylase level should be determined. The inaccuracies of the tests must be accorded due respect, but it is significant that the disease can be diagnosed in 95 per cent of the patients seen early in the course of the illness. The recognition of acute pancreatitis revolves about acceptance of the concepts that pancreatitis is a frequent cause of abdominal pain and the diagnosis can be established if considered.

MANAGEMENT

Innumerable therapeutic measures based on theory and presumed pathogenesis have been advocated for treatment. An analysis of the results indicate that there are three fundamental points of treatment which appear to

* Serum amylase concentration in normal subjects is 80 to 180 Somogyi units per 100 ml.

be based on physiologic principles. These basic points of treatment have as their objectives: (1) restoration of the whole blood volume, (2) placing the pancreas at physiologic rest by suppression of pancreatic secretion, and (3) correction of coexistent biliary tract disease after the acute episode has subsided. The use of blood has long been recommended as a general supportive measure, but after the demonstration of average deficits of 1,100 cc. plasma volume and 750 cc. red cell mass in patients with acute pancreatitis, the indication for early and more frequent use of whole blood and serum albumin is clear [3].

In the absence of research facilities for the measurement of blood volume, the most accurate determination of the blood volume status can be made by following the vital signs. A pulse rate of over 100, without elevated temperature or other metabolic cause, generally indicates a contracted plasma or whole blood volume.

In the present series blood and serum albumin were used only in the most seriously ill patients, and it is impossible to ascertain the benefit that might have been obtained by their more widespread use. In only two instances did fatal shock develop after admission. In the other six deaths which were due to shock, the hypotensive process, present on admission, failed to respond to transfusion, but transfusion was probably inadequate. This inadequacy is suggested by the fact that only two of the patients received an amount of blood equal to that previously described as an average deficit [3]. In several instances the incipient development of shock was recognized and treatment with whole blood was successful.

Achievement of the second basic objective of treatment, placing the pancreas at rest, is dependent upon diminishing the pancreatic secretion. This is best accomplished by controlling both the hormonal and cephalic aspects of pancreatic and gastric secretion. The hormonal or secretin pathway of pancreatic secretion is controlled by removing the gastric secretion via gastric suction, while the vagal stimulation of secretion is additionally diminished by the use of a parasympathetic blocking drug such as pro-banthine® or atropine. To prolong the diminution of secretion after the removal of the gastric tube, oral intake other than water should be avoided for forty-eight to ninety-six hours after even the mildest of attacks, as dietary intake is perhaps the most potent stimulus to pancreatic secretion and should be eliminated until all evidence of pancreatitis has subsided.

Forty-three of the patients received constant gastric aspiration and forty-one were given one or more parasympathetic blocking agents during the first day of treatment. The only significant trend, when comparing the treatment of patients admitted prior to 1953 with that of patients admitted after that date, has been the more frequent use of vagal blocking agents in recent years. Gastric suction has been used in approximately 50 per cent of the patients in both periods.

In the management of the immediate episode of acute pancreatitis, other aspects of therapy must be considered. The electrolyte and fluid balance must be restored in conjunction with blood volume correction, while pain must be relieved and provision made for management of peritonitis. The threat of secondary peritonitis was met by routine administration of either a penicillin-streptomycin combination or one of the wide-spectrum antibiotics.

While not utilized in this series, parathormone (200 units every six hours) and intravenous calcium chloride has been recommended in the presence of increased neuromuscular agitation or activity [4].

The third basic objective of treatment, removal of gallstones, is best accomplished after the acute episode has resolved.

It is wise to make every effort, including intravenous cholangiography, to determine the presence or absence of biliary stones during the initial hospital admission, as recurrent attacks may occur shortly after the acute episode has subsided. Cholecystography should be performed shortly after the acute symptoms subside, despite the observation that cholecystography may fail to outline a normal gallbladder as long as four to six weeks after an attack of acute pancreatitis [5,6]. If gallstones are present, early elective cholecystectomy and exploration of the common duct is indicated, as there seem to be few contraindications to biliary surgery shortly after disappearance of symptoms. If stones are not visible, however, and the gallbladder does not function, surgery should be withheld and the recommended therapy should include dietary measures of abstinence from alcohol and caffeine. The status of the gallbladder should be redetermined

after a lapse of six weeks, and if evidence of gallstones is present, the gallbladder should be removed and the common duct explored.

MORTALITY AND FOLLOW-UP

The immediate mortality rate in our group of patients was 14.6 per cent, or thirteen deaths in eighty-nine patients. (Table I.) The adoption of the aforementioned plan of therapy, based on physiologic knowledge of the pathogenesis of acute pancreatitis, should result in a lowering of the mortality rate. This review has disclosed two significant factors, namely, operative intervention during the acute phase was associated with a mortality rate twice that of the group in which non-operative treatment was utilized, and recurrent attacks of pancreatitis were quite frequent among the total group of survivors.

TABLE I
MORTALITY FROM ACUTE PANCREATITIS: 1948 TO 1955

	No. of Patients	No. of Deaths	Mortality Rate (%)
Males	43	9	20.9
Females	46	4	8.7
Totals	89	13	14.6

Of the sixty-six patients treated conservatively, eight died, giving a 12 per cent mortality rate. (Table II.) Among the twenty patients submitted to exploratory laparotomy (and in one patient, cholecystectomy) there were five deaths, a mortality rate of 24 per cent. This divergence in mortality rates undoubtedly resulted, in part, from the selection of patients. Nevertheless, others have indicated that operation during the acute phase raises the over-all death rate [7]. Except for diagnosis, it is difficult to conceive how simple laparotomy should in any way have helped these patients with uncomplicated pancreatitis.

The only instances in which operative intervention seemed to be of benefit occurred during the later phase of the disease process. Three collections of necrotic pancreas and pancreatic juice (acute pseudocyst) and two abscesses were drained seven to fourteen days after the onset of the illness. In all five instances abdominal masses developed either with or without signs of sepsis, and all patients survived. It is interesting that none of the entire group of patients was recognized as having a pseudocyst on admission, while 5.7 per cent required definitive drainage prior to discharge from the hospital. If evidence of infection develops, the collection must be drained; otherwise, little is to be gained by early drainage. Of the thirteen patients who died with the initial attack, only two died of sepsis and both had widespread peritonitis without a localized collection. It is unlikely that drainage would have altered the course of the disease in these two instances.

TABLE II
OPERATIVE VS. CONSERVATIVE TREATMENT OF ACUTE PANCREATITIS: 1948 TO 1955

	No. of Patients	No. of Deaths	Mortality Rate (%)
Operative treatment	21	5	24.0
Conservative treatment	68	8	11.8
Totals	89	13	14.6

TABLE III
FATE OF SURVIVORS FOLLOWED UP*

	No. of Patients	Per cent
Deaths:		
Recurrent pancreatitis	4	7
Other causes	2	3
Relapsing pancreatitis:		
Minor incapacitation	5	8
Moderate incapacitation	17	28
Major incapacitation	13	21
Living without recurrence	20	33

* Average period of follow-up of thirty-three months among sixty-one patients surviving their initial attack.

Death due to a second or third attack of acute pancreatitis appears to occur with surprising frequency in patients who have survived the initial attack. O'Brien and Thayer [8] reported four deaths from secondary attacks among eighty-eight patients in whom follow-up examinations were possible after the initial attack. Of seventy-six survivors, it has been possible to follow up sixty-one patients for an average of thirty-three months. There have already been four deaths due to recurrent pancreatitis

and its complications, and two other patients have died of unrelated causes. (Table III.)

The incidence of recurrence of symptoms in the remaining group has been quite high and has presented a formidable problem. Of the sixty-one who survived their initial attack, thirty-four have been followed up over three years and the other twenty-seven over one year.

Twenty-two patients (including the two who died of unrelated diseases) have not had recurrent attacks of pancreatitis, while five have had recurrent episodes of epigastric pain which have not seriously interfered with their activity. (Table III.) A majority, thirty-four, have had a serious recurrence of symptoms that has led to the diagnosis of relapsing pancreatitis. Thirteen have had attacks that occur at least every two months, with severity enough to result in incapacitation. These patients are "pancreatic cripples." The other seventeen living patients who have had from one to seven recurrent attacks have been incapacitated for shorter and more infrequent periods.

It is readily apparent that following an episode of pancreatitis the ultimate outlook for the individual patient must be guarded, as a certain number will die of recurrent acute pancreatitis. A larger segment of the group will have non-fatal recurrences. After institution of successful therapy for the initial episode, the patient must be carefully evaluated for his future is dependent upon intelligent selection of the correct method of treatment. In this group of surviving patients the prognosis following pancreatitis can be predicted by determining the alcoholic intake of the individual and the presence or absence of gallstones. In that group with biliary stones, 70 per cent have had effective relief following removal of the stones, while removal of a normal gallbladder has not lowered the rate of recurrence. In each instance in which recurrence of pancreatitis followed cholecystectomy for gallstones, sphincterotomy had been included as part of the initial procedure. Sphincterotomy has since been abandoned.

Unfortunately, the most striking fact has been the high rate of recurrence (72 per cent) in the alcoholic patient [9]. This is apparently due to the inability of the patient to give up this intolerable habit or perhaps to an unknown basic reason for the occurrence of pancreatitis in alcoholics. In 20 per cent of the alcoholics either pseudocysts or pancreatic calcification has developed in the short period of follow-up, while the non-alcoholics have remained relatively free of these complications.

Therapy for the alcoholic patient recovering from pancreatitis should be non-operative in the initial phases. Concepts of treatment should include withdrawal of alcohol, a bland diet, antacid intake and the use of vagal blocking agents. A high rate of recurrence is to be expected. Thereafter, careful selection of one of the many surgical procedures based on the status of the disease and its manifest complications is indicated. It seems unlikely that biliary surgery will offer relief if the gallbladder is normal.

SUMMARY

Pancreatitis is being recognized as a cause of abdominal pain with increasing frequency. The diagnosis is most often made or confirmed by the presence of an elevation of the serum amylase concentration. A high index of suspicion induced by a careful history and physical examination should lead to the even more frequent recognition.

The acute episode is best treated by conservative measures based on physiologic concepts of restoration of blood volume and diminution of the pancreatic secretion. After recovery, biliary tract disease should be corrected; most of the patients will be relieved of symptoms.

The removal of a normal gallbladder or other surgery on the biliary tract in the absence of intrinsic disease has not favorably influenced the rate of recurrent attacks.

The incidence of recurrent pancreatitis is remarkably high in the lower income group, presumably on the basis of the high incidence of alcoholism. If conservative therapy fails in the alcoholic patient, and it frequently does, the careful selection of the operative procedure must be based on complications already manifested in the individual patient.

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Foreign Body Perforation of the Intestinal Tract

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THE ingestion of foreign bodies is rarely associated with intestinal perforation even though the swallowed object is sharp. Only scattered case reports have followed the ninety-five cases of gastrointestinal perforation reported from a review of the literature by McManus [7] in 1941. Although 10 to 20 per cent of ingested foreign bodies will fail to pass through the entire gastrointestinal tract, less than 1 per cent cause perforation.

The variety of clinical manifestations of intestinal perforation coupled with the usual absence of a history of foreign body ingestion makes this relatively rare complication difficult to diagnose but worthy of consideration in patients with unexplained peritonitis, intra-abdominal abscess or intestinal obstruction. Six cases of foreign body perforation of the intestinal tract have been seen at the University Hospital during the past ten years. These cases are reported to stress some of the interesting facets of foreign body perforation.

CASE REPORTS

Individual case reports are replaced by a chart which shows the pertinent findings in each case. (Table 1.) Two features of foreign body perforation not previously reported or sufficiently emphasized in the literature have been noted in our cases. These are the relative frequency of associated chronic intestinal obstruction and the use of dentures. The former may permit perforation at unusual sites while the latter probably is instrumental in the unknowing ingestion of sharp foreign bodies.

COMMENTS

It is interesting that the problem of foreign body ingestion first came into the foreground by the accidental ingestion of a buckle by Frederick William 1 in his infancy [6]. That it passed through without significant complica-

TABLE 1
INTESTINAL PERFORATION BY FOREIGN BODIES (SIX CASES)

Age (yr.) and Sex	History of Ingestion	Duration of Symptoms (days)	Foreign Body and Site of Perforation	Dentures	Chronic Obstruction
80, F	Yes	3	Straight pin, appendix	Yes	Yes
62, M	No	28	Chicken bone, sigmoid	Yes	Yes
63, M	No	10	Chicken bone, ileum	Yes	No*
62, M	No	14	Toothpick, unknown (in omentum)	Yes	No*
47, F	No	4	Chicken bone, ileum	Yes	Yes
75, F	No	3	Chicken bone, sigmoid	No	Yes

* Inguinal hernia present.

tions was evidenced by his ability to produce his famous offspring, Frederick the Great. In 1602 the first gastrotomy for foreign body was reported by Mathis [2]. The patient was a professional juggler who had swallowed a knife. The first appendectomy was performed by Claud Amyand in 1735 on an eleven year old boy who had a draining sinus of the right thigh which communicated with a right scrotal hernia sac containing an appendix which had been perforated by a pin [1].

In view of the frequency of foreign body ingestion, it is remarkable how seldom perforation of the gastrointestinal tract occurs. Henderson [5], in 1938, reported 800 cases of foreign body ingestion seen at the Boston City Hospital in twenty-one years in which perforation occurred in only nine patients, representing a 1 per cent incidence. This incidence, of course, is even less when it is remembered that a great number of ingestions are not reported, either because symptoms are lacking or the ingestion is unknown. Gross [4] presented a series of 766 ingestions and stated that 25 per cent lodged in the esophagus and gave symptoms of choking, dysphagia or discomfort. He stated that of those objects which reached the stomach, 93 per cent passed through the intestinal tract without incident and that only 0.6 per cent caused perforation.

McManus [7], in 1941, reported a review of the literature which contained only ninety-five cases of gastrointestinal perforation by foreign bodies. Fifty per cent of the patients were in the first three decades of life. Metallic objects such as pins and wire were responsible for 46 per cent of the perforations, and animal bones including those of fish, chicken and rabbits accounted for 46 per cent. Wood splinters, toothpicks and pencils caused the remaining 9 per cent of the perforations.

Certain factors play a prominent role in the etiology of ingestion of foreign objects. Carelessness is the most frequent violation, particularly in children. Other causes include poor vision, mental infirmity, rapid eating, drug addiction, a dare and absent-mindedness. The use of dentures has not been adequately stressed as a cause of ingestion of sharp foreign bodies. Five of our six patients were edentulous and wore dentures. The lack of normal palatal and gingival sensation probably plays an important role, permitting the accidental ingestion in these patients [5].

The sites of perforation varied as have those reported in the literature. The ileocecal region was the most common area for perforation, a finding which is difficult to explain on an anatomic basis. Perhaps either the ileocecal valve offers some obstruction or the relative thinness of the bowel wall in this area are factors; however, two of our perforations occurred in the sigmoid colon.

It is conceivable that any obstruction to flow in the intestinal tract would predispose to perforation by a sharp foreign body. In the older age group chronic obstruction due to a hernia, postoperative adhesions or atony of the bowel is more frequent and therefore could explain our correlation of perforation with both advanced age and obstruction. Four of our six patients did have histories or operative evidence suggesting chronic obstruction prior to the estimated time of perforation. The other two patients with inguinal hernias might be suspected of having obstruction, but no such history could be obtained.

The diagnosis of foreign body perforation is easy if a history of ingestion is available. The majority of patients who know they have swallowed a sharp metallic foreign body usually seek medical advice. The difficulty in diagnosis arises, however, in the patient who has unknowingly swallowed a foreign object. If the object is radiopaque, the x-ray film will aid in the diagnosis. In our cases, the diagnosis of perforation by non-opaque objects was only suspected in one case preoperatively. As reported in the literature, other diseases were simulated, including appendicitis, localized abscess, diverticulitis and intestinal obstruction. In addition, as pointed out by Ginzburg [3], an abdominal wall abscess may develop in these patients due to adherence of the wall of the gut to the anterior abdominal wall before the actual perforation occurs.

The treatment of foreign body perforation is directed to the complication which it has produced. Since a correct diagnosis is rarely made before surgery, the principles of surgery cannot be outlined. Great care should be given to the management of intestinal obstruction and peritonitis if a low mortality is to be achieved. Only one of the six patients reported died postoperatively; this patient had extensive carcinomatosis and died of overwhelming infection. When surgery is performed for the lysis of idiopathic adhesions, peritonitis or intra-

abdominal abscess, a foreign body should be considered and removed if present.

SUMMARY

Six cases of foreign body perforation of the intestinal tract have been presented and the literature has been briefly reviewed. Although foreign body perforation is relatively rare, it should be considered in atypical cases of peritonitis, intra-abdominal abscess or intestinal obstruction. The use of dentures, which prevent pain on mastication of bones or toothpicks, probably plays a major role in the ingestion of sharp foreign bodies in adults. Chronic partial intestinal obstruction preceded the acute perforation in two-thirds of our cases and may be responsible in part for the perforation from ingested foreign bodies which might otherwise have passed uneventfully.

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Cancer of the Colon, Rectum and Anal Canal*

SURGICAL APPROACH WITH RATES OF FIVE- AND TEN-YEAR SURVIVAL

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THE surgical treatment of patients with cancer in various portions of the large bowel has undergone significant change during the past two decades. Due to careful preoperative preparation, refinements in postoperative care and improvements in anesthetic management, an extended degree of radicality has been permitted, the results of which are particularly encouraging in terms of mortality, morbidity and long term survivals.

TABLE I
CANCER OF COLON, RECTUM, ANAL CANAL
(Author's Series—September, 1940–December 31, 1956)

No. patients	1,663
No. operated upon	1,501
No. resected	1,371
Resectability rate	91.2%
Mortality rate (1,371 resections)	3.7%

The purpose of this report is to record our experiences in a series of 1,663 patients with cancer of the colon, rectum and anal canal, covering the sixteen year, four month period from September 1, 1940 to December 31, 1956.

A review of my records discloses that of the 1,663 patients with cancer of the large bowel, 1,501 were subjected to some type of operation, i.e., resection, colostomy, colotomy and polypectomy, or celiotomy (open and closed). Resection, either for "cure" or palliation, was performed in 1,371 patients brought to the operating room, a resectability rate of 91.2 per cent. (Tables I and II.)

CANCER OF THE CECUM, ASCENDING COLON AND HEPATIC FLEXURE

Lesions in this anatomic position have been removed by right hemicolectomy with end-to-

TABLE II
CARCINOMA OF THE COLON, RECTUM AND ANAL CANAL
(Author's Series—1940–1956)

Site	No. Undergoing Resection	No. Deaths from Resection	Mortality Rate (%)	Survival Rate, Five Years (%)	Survival Rate, Ten Years (%)
Cecum, ascending colon and hepatic flexure	46	2	4.5	57.1	....
Transverse colon and splenic flexure	28	1	3.5	53.8	....
Descending colon and sigmoid	326	11	3.3	68.1	56.3
Low sigmoid, rectosigmoid and upper rectum; abdominoperineal proctosigmoidectomy	619	25	4	55.1	39.2
Low rectum (lower 4 cm. of rectum)	307	11	3.5	49.7	38.4
Anal canal (squamous cell carcinoma)	45	1	2.2	31.5	....
Totals	1371	51	3.7	....	....

* Read before the Cuban Surgical Society, Havana, Cuba, January 16, 1957.

side anastomosis between the ileum and distal transverse colon to include their mesentery and node-bearing areas around the superior mesenteric vessels. The ileocolic, right and middle colic vessels are ligated at their origin. The superior mesenteric artery should be exposed and the region meticulously cleared of node-bearing tissue. On occasion this latter procedure has often been difficult. The middle colic arteries are sacrificed, thereby placing reliance on the ascending ramus of the left colic artery. Our experience with cancerous lesions in this locality encompasses forty-six patients. (Table III.)

TABLE III
CECUM, ASCENDING COLON AND HEPATIC FLEXURE

No. patients	46
No. resected 5 or more yr. ago	34
No. surviving 5 yr	16
5-yr. survival	57.1%
Mortality rate	0

Of this number, thirty-four were resections performed five or more years ago. There were no operative deaths; palliative resection was performed in three, two patients died of causes other than malignancy, and one was lost to follow-up. There remain twenty-eight patients operated upon for cure. Sixteen patients are known to have survived the five-year period. Thus the salvage or survival rate is computed as 57.1 per cent.

$$\frac{16 \times 100}{34 - 6} = 57.1\%$$

Thus 1,600 ÷ 28 = 57.1 per cent five-year survival.

CANCER OF THE TRANSVERSE COLON AND SPLENIC FLEXURE

A decade or so ago it was customary to resect the mobile portion of the transverse colon without mobilization of the flexures unless the splenic segment was involved. The fallacy of conservative resection was soon appreciated, and for this reason the distal ascending, entire transverse and proximal descending colon are removed, preserving thereby the right colic and superior ramus of the left colic arteries for the anastomosis. In all cases the gastroepiploic nodes are cleared and the transverse mesocolon and omentum removed. More recently on occasion we have extended the procedure by extirpating the entire colon with anastomosis of the ileum to the mid-portion of the sigmoid. In some instances concomitant splenectomy has been instituted although we have not been impressed with the recommendation of Madden [1] that partial pancreatectomy be an added feature.

TABLE IV
CANCER OF TRANSVERSE COLON AND SPLENIC FLEXURE

No. patients	28
No. resected 5 or more yr. ago	18
No. surviving 5 yr	7
5-yr. survival	53.8%
Mortality rate	3.5%

There were twenty-eight patients with cancer in this region, eighteen of whom underwent resection more than five years ago. There was one operative death, two were classified as palliative resections because of liver metastasis, one patient died of causes irrelevant to cancer, and one was lost to follow-up. Of the remaining thirteen patients, seven are known to be alive and well for a period of five years or more, a survival rate of 53.8 per cent. (Table IV.)

$$\frac{7 \times 100}{18 - 5} = 53.8\%$$

Thus 700 ÷ 13 = 53.8 per cent five-year survival.

CANCER OF THE DESCENDING AND SIGMOID COLON

Lesions in these sites are encountered with greater frequency than in the more proximal portions. Except for cancer of the low sigmoid, it had been our policy to perform segmental resection for tumors in the descending colon and sigmoid proper to include a portion of the mesentery and mesosigmoid. However, accrued evidence demonstrating the presence of multiple lesions [2,14] in the resected specimens [3,4] and by coloscopy [5] made it mandatory to extend the degree of extirpation to remove the entire left colon and anastomose the transverse colon to the lower sigmoid [6].

A few years ago the author became intrigued with the original recommendation of Moynihan [7] that for radicality the glands about the inferior mesenteric vessels, which we now refer to as the "axilla of the abdomen," should be

removed. It will be recalled that this recommendation was revived by Ault et al. [8] in 1950, and investigated further by Grinnell and Hiatt [9] in 1952, Snellman [10] in 1953 and Rosi [11] in 1954. We recorded our experience with seventy-one cases of abdominopelvic lymphadenectomy at a meeting in New York in December, 1951, which was published in January, 1953 [12]. Subsequent reports by us have appeared in the literature [13,15,16], the most significant of which was the fact that of 168 operative specimens cleared by the Spalteholz-Gilchrist technic, 19.7 per cent showed positive nodes located in the region of the origin of the inferior mesenteric artery. To the time of this writing the author has performed abdominopelvic lymph node dissection with ligation of the inferior mesenteric artery at its aortic origin in 371 patients. (Table v.) In not a single case can we attribute death to this procedure; one complication, namely, an infected hematoma has been encountered. We employ this maneuver routinely in all patients with carcinoma of the descending and sigmoid colon, rectum and anal canal when instituted for cure. The only exception is in poor risk patients and in those of advanced years, usually seventy years of age or over.

TABLE V
AORTOILEOPELVIC LYMPHADENECTOMY

No. patients	371
No. specimens cleared	168
Positive inferior mesenteric nodes	19.7%
Mortality attributive to procedure	0
Complication (infected hematoma)	1

Our experience with cancer of the descending colon and sigmoid embraces 326 patients, 218 of whom were operated upon five or more years ago, or prior to December 31, 1951. In this group there were seven deaths following resection, a mortality rate of 3.2 per cent; palliative resection was performed in nineteen (metastasis to the liver) and seven patients died of causes other than cancer. In addition, nine patients were not followed up. Of the remaining 176 patients, 120 have survived the five-year period. The salvage rate is computed as 68.1 per cent. (Table VI.)

$$\frac{120 \times 100}{218 - 42} = 68.1\%$$

Thus 12,000 ÷ 176 = 68.1 per cent five-year survival.

Ten-Year Survival. A review of our records shows that ninety-one patients were resected ten or more years ago, or prior to December 31, 1946. In this group there were three postoperative deaths, a mortality rate of 3.3 per cent; palliative resection was performed in nine, four patients died of causes other than cancer, and four were lost to follow-up. With the deletion of these twenty, seventy-one are left. Of this number, forty patients, either by recent examination or letter, are alive and well ten or more years following operation, a salvage rate of 56.3 per cent. (Table VI.)

TABLE VI
CANCER OF DESCENDING COLON AND SIGMOID

No. patients	326
No. operated upon 5 or more yr. ago	218
No. patients surviving 5 yr	120
5-yr. survival rate	68.1%
Mortality rate	3.3%
No. patients operated upon 10 or more yr. ago	91
No. patients surviving 10 yr	40
10-yr. survival rate	56.3%

$$\frac{40 \times 100}{91 - 20} = 56.3\%$$

Thus 4,000 ÷ 71 = 56.3 per cent ten-year survival.

CANCER OF THE RECTOSIGMOID AND AMPULLARY RECTUM

In our department of rectal and colonic surgery it has been our custom to remove all cancerous growths of the distal sigmoid, rectosigmoid and ampullary rectum (those above 7 cm. from the anal margin or 4 cm. above the anorectal line) by the technic of abdominoperineal proctosigmoidectomy without abdominal colostomy and with preservation of the anal sphincters. In published articles the author has detailed his experiences with the procedure in its various phases, a repetition of which would be superfluous in this discussion [6,12,13, 15–29]. Suffice to state the results achieved, particularly in the rates of five- and ten-year survival, are a little better than those obtained through other types of surgery for cancer of the rectum. In this procedure mobilization of the rectum, sigmoid and major portion of the

descending colon is effected and abdominopelvic lymph node dissection instituted during the abdominal phase of the operation. In the perineal portion the sphincter musculature is meticulously dissected free and preserved together with the anoderm of the anal canal.

TABLE VII
CANCER OF THE RECTOSIGMOID AND AMPULLARY RECTUM

No. undergoing proctosigmoidectomy without colostomy and preservation of anal sphincters	619
No. patients surviving 5 yr	446
5-yr. survival	55.1%
10-yr. survival	39.2%
Mortality rate	4%

Thereafter, the mobilized bowel is drawn through the aperture created by the stretched sphincters and subsequently sutured to the anoderm.

Our experience includes 619 cases, in which there were twenty-five deaths from operation, a mortality of 4 per cent. In 446 of the 619 cases resection was performed more than five years ago, or prior to December 31, 1951. In this group there were twenty-one deaths from operation (4.7 per cent), sixty-five palliative resections, five patients with sarcoma and twenty-one who dies of causes other than malignancy with no evidence of recurrence at their last examination or at the time of their death. In addition, twenty-two patients were lost to follow-up. Consistent with the Newman-Dukes method of computation, the total of 134 subtracted from the 446 patients undergoing resection five or more years ago leaves 312. Of this number, 172 patients are known to have survived this period, a salvage rate of 55.1 per cent. (Table VII.)

$$\frac{172 \times 100}{446 - 134} = 55.1\%$$

Thus 17,200 ÷ 312 = 55.1 per cent five-year survival.

Ten-Year Survival. To determine the ten-year salvage rate, the records of patients operated upon prior to December 31, 1946, were reviewed. One hundred fifty eight patients were submitted to this procedure, with nine deaths postoperatively, a mortality rate of 5.6 per cent. In the group of 158 patients, there were nine with liver metastasis for whom palliative resection was performed, fourteen who died of causes other than malignancy and fourteen who were lost to follow-up. Elimination of this total of forty-six subtracted from the 158 leaves 112 who were followed up. Of this number, forty-four patients, either by examination or by letter, are known to be alive ten years or more, which represents a salvage rate of 39.2 per cent. (Table VII.)

$$\frac{44 \times 100}{158 - 46} = 39.2\%$$

Thus 4,400 ÷ 112 = 39.2 per cent ten-year survival.

CANCER OF THE LOW RECTUM

All patients with cancerous lesions involving the distal 4 cm. of the rectum and those with squamous cell carcinoma of the anal canal are subjected to an abdominoperineal excision popularly termed the Miles operation. It should be mentioned that the procedure as originally described and as usually executed is not in itself sufficiently radical to serve as a sound operation for cancer [*16*]. Besides an aortoileopelvic lymph node dissection to which we have referred, the endopelvic fascia must be removed, the ischiorectal fossae cleared of their fat and the perianal skin widely removed. Complete excision of the pelvic peritoneum may be required and can be accomplished without complications. To date, seventy-one patients have been treated without re-establishment of a pelvic floor [*30–32*]. The value of removing adherent organs cannot be overemphasized and our studies will attest to the correctness of these facts [*33–35*].

Inasmuch as squamous cell carcinoma of the anal canal carries a poorer prognosis than adenocarcinoma of the rectum, it is proper that these be discussed separately even though the method of abdominoperineal excision was employed in each.

There were 307 patients with carcinoma of the low rectum for whom this method was used. Of this number, 236 underwent this procedure five or more years ago, with eight postoperative deaths, a mortality rate of 3.3 per cent. Besides the eight deaths, twenty-three palliative resections were performed, eleven patients died from causes other than cancer, five died with sarcoma, and ten are untraced; all these cases are eliminated. By subtracting these fifty-seven from the 236 resections performed five years ago, there remain 179 patients, of whom eighty-

nine are known to be alive, for a five-year survival rate of 49.7 per cent. (Table VIII.)

$$\frac{89 \times 100}{236 - 57} = 49.7\%$$

Thus 8,900 ÷ 179 = 49.7 per cent five-year survival.

TABLE VIII
CANCER OF LOW RECTUM

No. patients (abdominoperineal excision, Miles)	307
5-yr. survival	49.7%
10-yr. survival	38.4%
Mortality rate	3.3%

Ten-Year Survival. Determination of the ten-year salvage rate of patients undergoing the Miles operation for cancer of the low rectum was made by reviewing the records of patients prior to December 31, 1946. Ninety-six patients were submitted to this procedure, with six deaths, an operative mortality rate of 6.1 per cent. Besides the six deaths eleven palliative resections were performed, six patients died of causes other than cancer, two died with sarcoma and six were lost to follow-up; all these cases were deleted. By subtracting these thirty-one from the ninety-six resections performed more than ten years ago, there remain sixty-five patients of whom twenty-five are known to be alive and free of recurrence, for a ten-year salvage rate of 38.4 per cent. (Table VIII.)

$$\frac{25 \times 100}{96 - 31} = 38.4\%$$

Thus 2,500 ÷ 65 = 38.4 per cent ten-year survival. This rate is similar to reports of others [*26,36–38*].

CANCER OF ANAL CANAL

It is common knowledge that cancerous lesions in this site other than those of the basal cell variety, of which we have encountered four during the past sixteen years, offer a poor prognosis. It is for this reason that an abdominoperineal excision, usually the method of Miles is performed. Customarily, we have attempted to approach the problem in a more radical manner by stripping the lower abdomen and pelvis of all node-bearing tissue. The dissection is begun immediately below the third portion of the duodenum, continued over the vena cava, the aorta and iliac vessels and into the depth of the pelvis. In the course of the lateral dissection the external iliac arteries are stripped as far as Poupart's ligament which will be met subsequently by the upper extent of the inguinal node dissection. It is particularly important to clear the ischiorectal fossae of fat, to include the rectourethralis muscle in the male,

TABLE IX
CANCER OF ANAL CANAL

No. undergoing abdominoperineal excision, Miles	45
5-yr. survival	31.5%
Mortality rate	2.2%

to denude the prostate of Denonvilliers' aponeurosis and Reinhold's fascia, and to excise widely the levators as well as a large expanse of perianal skin. To assist in the dissection of the anterior portion of the perineum in the male, it is helpful to have had a metal sound inserted into the urethra. Ordinarily a bilateral inguinal node dissection is performed ten to fourteen days following abdominoperineal procedure.

A review of our records reveals a series of forty-seven patients with squamous cell carcinoma of the anal canal. Of this number, one patient received radiotherapy and another refused treatment. In the remaining forty-five patients abdominoperineal excision was instituted; twenty-four of these patients were operated upon five or more years ago. There was one operative death, three procedures were declared "palliative" because of positive groin nodes as determined by histopathology, and one patient was lost to follow-up. Of the remaining nineteen patients, six are known to be alive, for a five-year survival rate of 31.5 per cent. (Table IX.)

$$\frac{6 \times 100}{25 - 5} = 31.5\%$$

Thus 600 ÷ 19 = 31.5 per cent five-year survival.

SUMMARY AND CONCLUSIONS

A series of patients with proved malignancy of the colon, rectum and anal canal is reported. Experience with an extended degree of radicality is cited, together with the results with aortoileopelvic lymphadenectomy. The inci-

dence of five- and, in some instances, the ten-year survival are recorded.

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Repair of the Incontinent Sphincter Ani

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ONE compelling circumstance has always thwarted the ideally attainable repair of the incontinent sphincter ani. That circumstance was postoperative muscle tension on its sutured free ends, adversely abetted by the factor of an unavoidably infected field. No matter how cleverly conceived and executed the plan of repair, there was always that inexorable and devastating wound disruption in certain prospect during the postoperative period.

This is not to say that all effort and skill of surgical intervention have been to no avail, for worthwhile improvement has proved to be possible. However, one never achieved as a final result the favorable status viewed with satisfaction at the close of operation. In this connection we previously focused attention on the concept of the "frozen wound" which obtained here and accounted for most of whatever improvement resulted. That is, after a period of time the various components of the wound became reasonably stabilized or "set" in their new relationship to each other and gain was realized chiefly by this means. Thus while primary union was the phantom goal sought for maximum improvement, secondary healing embraced potentialities which were indeed clinically welcome.

This relative failure was due primarily to the deficiencies of conventional retention sutures, ascribable in turn to two factors. Essentially these were inability to distribute the unusual tension over a sufficiently wide suture surface to avoid eventual tearing and, secondly, the retention sutures as used were part and parcel of an invariably infected main operative wound. Thus there was no escaping the inevitable consequences of tension in the presence of infection, an extremely unpropitious background for plastic surgery. In spite of many useful details described in the literature, five days was the usual limit of useful apposition.

Now for the first time we have devised a plan of operation for the repair of the incontinent sphincter ani which has surmounted the problem of retention and has therefore proved correspondingly superior in final result. This goal signifies, since our previous reports [*1–3*], the accomplishment of effectual containment of wound tension during the critical period of healing. It means, for the first time, the assurance of healing approaching primary union in character and of an end result in terms of the immediate postoperative status.

The new principles involved in our plan of operation have their beginning in the utilization of completely circumferential splinting of the sphincter muscle during the period of healing. This is accomplished by an aseptically introduced silver wire completely around and outside of the sphincter and wholly independent of the main operative wound. Introduced before the main operation, it is arranged to be tightened after operation to the point of holding the united ends of the sphincter effectively in place for any period of time desired, even to the point of permanency if so elected. This arrangement and planned sequence corrects previous deficiencies in that it provides for distribution of suture tension over a relatively enormous surface and additionally establishes complete separation and protection of retentive forces from main wound infection. Such use of a silver wire has been described for permanent alleviation of hopeless incontinence, which fact in itself bespeaks its potentialities. In view of this, we made suggestion of its temporary employment as herein described several years ago [*3*]. Since then its practical application and trial have most happily borne out the theoretic advantage envisioned at that time. Never before have we experienced anything approaching such ease of accomplishment and dramatic end result.

In previous papers we have discussed many

FIG. 1. Large needles being inserted from posterior to anterior stab wounds. The muscle is hugged closely and deeply except where avoiding the main field of operation. Advantage is taken concomitantly to ascertain by palpation the exact topography of the sphincter muscle. This is important in assuring participation and inclusion of full-thickness of muscle in the "muscle-bearing" flaps.

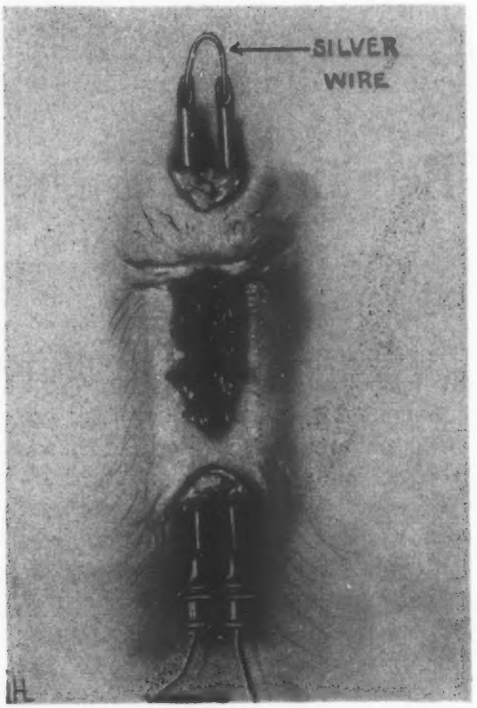

FIG. 2. Needles (15 gauge) in place, and length of 19 gauge silver wire passed. Needles are then withdrawn, leaving wire in place.

aspects of the problem of the incontinent sphincter ani which will not be repeated herein. However, from the standpoint of our present topic, that of technic, we must repeat and include for the sake of completeness an important principle previously described and elaborated upon. This is because extended use has so firmly substantiated its worth that we regard it an essential component of our present plan. From early personal experience with this type of surgery our first insistence was that the dissection carried out for repair of the incontinent sphincter ani must be simple. While simplicity is usually an obvious virtue, there were special reasons pertaining here. At all events this conceived necessity leads us to the idea and utilization of full-thickness flaps bearing complete sections of muscle for the repair of the damaged muscle. This was instead of what at that time was the conventional plan involving tedious and unsatisfactory dissection of frayed muscle ends lost in masses of scar tissue. The details of pattern will, of course, vary with individual cases and circumstances, but the principle of muscle-bearing flaps has been adopted by us as standard procedure. At this writing we illustrate its application to the most common type of injury and the condition found at operation.

It has been assumed by some that wound infection played a more important role than tension in disruption of the wound. With this in mind there has been employment of colostomy as a preliminary procedure. Such a program involved, of course, two major operations and months of elapsed time. We have never resorted to this extreme nor seen a report on the results, nor have we knowledge as to whether the results justified a surgical program of such magnitude. At this writing the matter would seem largely moot because by our method the wound ends may now be so effectively apposed that they must eventually heal at or near their new relative position, infection or no. However, we do employ commonly used sterilization of the bowel contents before and after surgery, although without evidence as to its role or importance. Suffice it at the moment that our end results are to us sufficient proof that with the present complete plan colostomy is unwarranted. The operation herein described is simple and expeditious, in contrast to the long, tedious dissections and repairs previously employed.

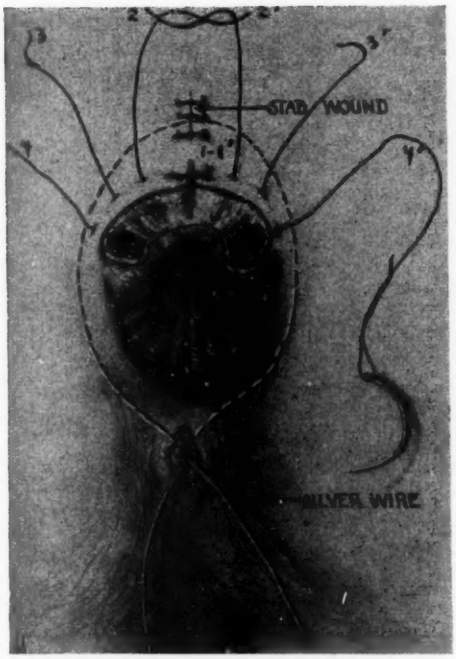

FIG. 3. Silver wire in place. The anterior stab wound has been sutured. Muscle-bearing flaps have been fashioned and scar tissue between the ends has been dissected out in a broad wound. Interrupted sutures placed (one already tied). This plan of suturing avoids buried material and assures broad surfaces in apposition.

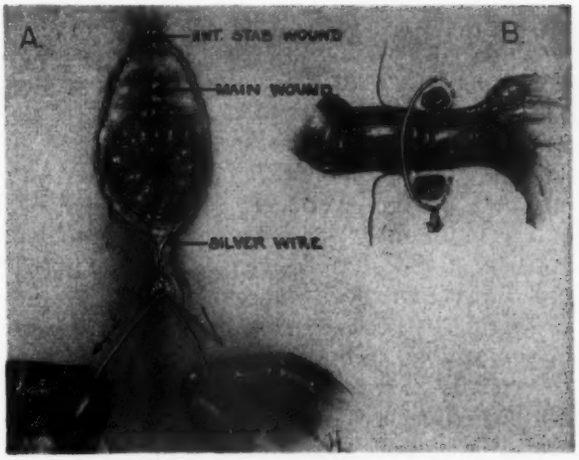

FIG. 4. A, repair completed; silver wire about to be tightened and then twisted. B, the wire is tightened and twisted sufficiently to fit snugly around assistant's finger in the anal canal. In twisting, one must be sure that both ends participate or it will not hold. Finally, the posterior stab wound is sutured.

TECHNIC

The patient is given a non-residue diet for three days before hospitalization, and then during two days of hospitalization preceding surgery is prepared with the combination of neomycin,® sulfathalidine® and castor oil.

At operation the exact field of dissection is first decided upon and mentally pictured and placed. Then an incision ½ inch deep is made close to but just outside this area in the midline, and a similar incision is made just outside the sphincter muscle in the posterior commissure (in the particular case illustrated).

Two 15 gauge 3 inch needles are then passed from one incision to the other, hugging the muscle all around on either side except where avoiding the future main operative wound. This maneuver with the needles is accomplished with the help of the free forefinger inside the anal canal apposed to the thumb on the outside. (Figs. 1 to 5.) Most important, too, advantage is thus taken to determine with exactitude in the mind's eye the topography of the sphincter muscle, for the catastrophic mistake is easily made of not including whole muscle section in the "muscle-bearing flap" to

FIG. 5. Photograph of end result of case in Figure 3. Before surgery the opening was patulous and the muscle ends 1½ inches apart. Healed wound is linear and near approach to primary healing apparent. This patient had had to wear a perineal pad continuously before operation because of seepage. Following surgery even control of gas became possible.

be fashioned. Soiled gloves are discarded immediately thereafter for fresh sterile ones. A sufficient length of No. 19 silver wire is then passed through both needles as illustrated, but the ends are left unfastened pending completion of the main operation. The upper stab wound is sutured at once.

The main dissection is then undertaken. This consists simply of deep transverse severance of tissue at the site of the muscle ends and removal of scar tissue between them, that is, at the site of the original injury. The wound is fashioned sufficiently wide to give broad healing surfaces. No buried sutures are used, and apposition of the surfaces is obtained by through and through non-absorbable suture material.

Then, following a complete change of gloves, the ends of the silver wire are twisted tight against an assistant's forefinger introduced just inside the anus. (One must be certain that both ends twist.) The remnant is cut with a wire cutter and the original incision sutured.

Bowel movements are kept soft but not runny for several weeks, and the wire is retained as indicated by the healing of the main wound. In our last case, illustrated in Figure 5, the wire was removed after three weeks.

SUMMARY

A plan for repair of the incontinent sphincter ani is described which for the first time affords adequate, dependable and extended retention of the surgical wound postoperatively. This in turn gives far greater assurance of primary healing, which has heretofore been so difficult to achieve.

Attention is again called to the use of muscle-bearing flaps, instead of dissected and frayed muscle ends, as an essential component of the present technic.

The new method of retention and the principle of muscle-bearing flaps together comprise our present approach.

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Elective Resection for Sigmoidal Diverticulitis

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THE treatment of diverticulitis of the colon has tended to follow a traditionally conservative course. This approach has long been justified by the comparative rarity of this condition as well as by the dangers formerly inherent in procedures involving resection of the large bowel [*1,7*]. In 1951 Swinton [*2*], reporting on work done at the Lahey Clinic, stated that 10 per cent of 1,000 patients had diverticula of the colon and ten had diverticulitis. At that time he stated that the cases requiring surgery are uncommon and that operation should be done only for the complications of diverticulitis. The incidence reported by him parallels the figures given by other investigators. However, it cannot be denied that the various complications of this disease may constitute a formidable technical problem in surgical therapy. It is also known that as the patient afflicted with colonic diverticulitis becomes older he may be subjected to a series of episodes of progressive and worsening disabilities which may lead to his death. It is only logical to state that if therapy could be established to prevent the occurrence of such complications, morbidity and/or death would be avoided.

The recent literature has shown a more aggressive approach to this problem [*4*]. Experience with primary resection and anastomosis for carcinoma of the colon in recent years has demonstrated that this operation can be done with a mortality as low as 1 per cent [*5*]. In 1950 Boyden [*3*] reported a series of twenty-five cases of resection and primary anastomosis for the treatment of diverticulitis of the colon without a mortality. It is fortunate that 80 to 90 per cent of cases of diverticulitis occur in the sigmoid colon, an area which is easily accessible to resectional surgery [*6*]. The real difficulty would lie not so much in the elective resection of sigmoidal diverticulitis but rather in the establishment of criteria for the use of this major procedure before extensive complications have occurred [*8*].

This report outlines our experience with sigmoidal diverticulitis in two hospitals between 1946 and 1955. In doing this study at the Coney Island Hospital and at the Brooklyn Jewish Hospital we were especially interested in the

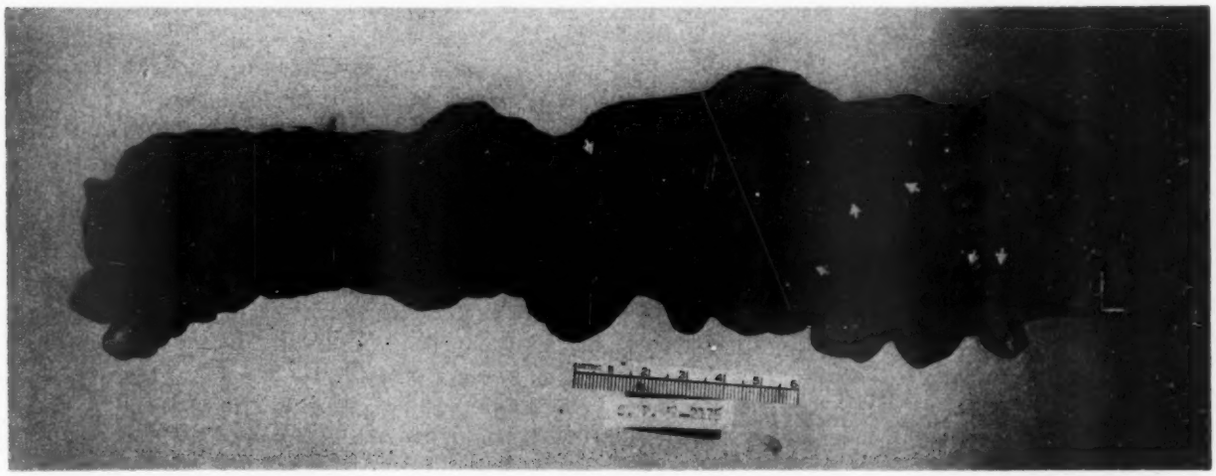

FIG. 1. Gross specimen showing the appearance of the mucosa in a case of diverticulitis. Note the nipple-like openings of the diverticula.

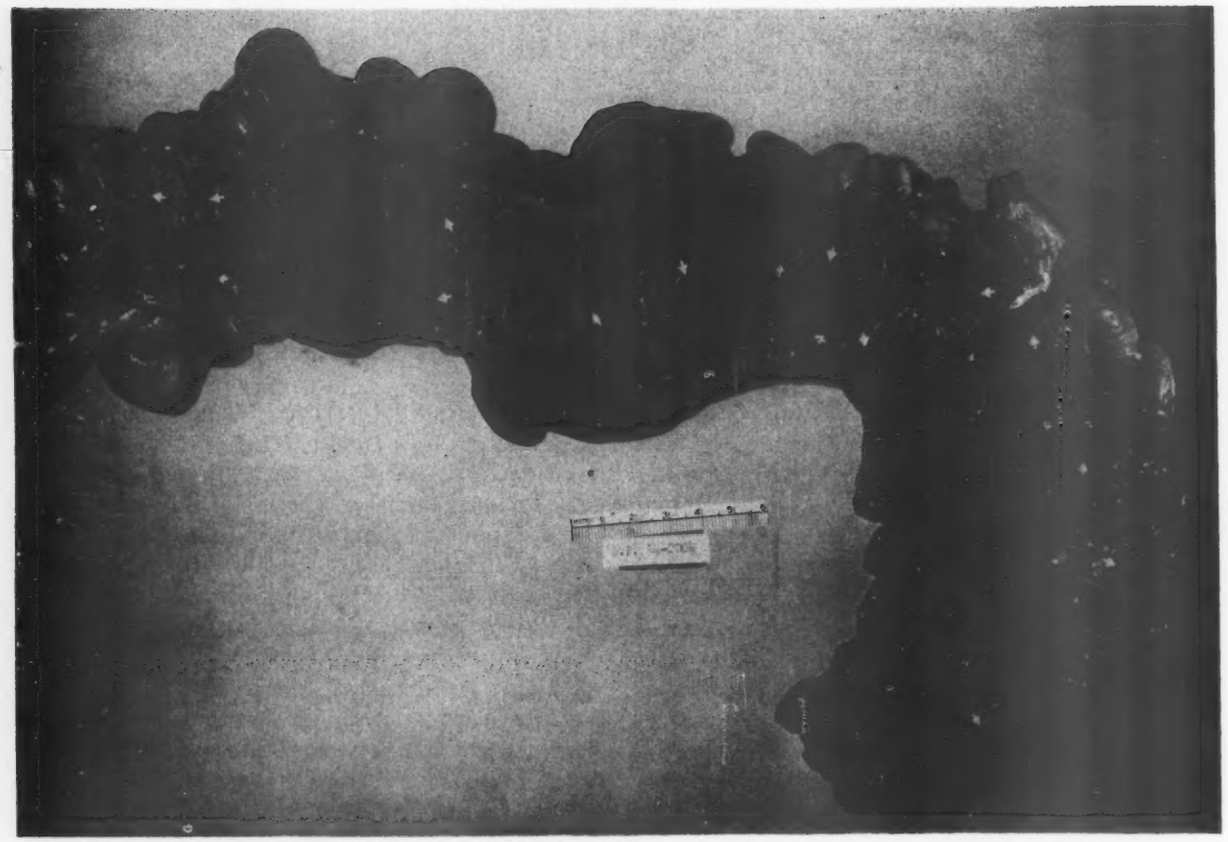

FIG. 2. Another example of the appearance of the mucous membrane in diverticulitis of the sigmoid.

age of patients, and in the duration and complexity of symptoms in relation to morbidity and mortality. It soon became evident to us that elective surgery earlier in the course of the disease was the preferred treatment.

The pathologic picture of diverticulitis coincides with the symptoms, physical signs and roentgen findings. The condition is essentially an inflammatory process superimposed on a structural alteration in the bowel wall. Figures 1 to 3 illustrate the gross appearance of the mucous membrane in a case of diverticulitis of the descending colon. One can see the openings of the diverticula surrounded by nipple-like elevations resembling the openings of valves. It will be observed in Figures 4 and 5 that the muscular coat is fragmented and that the mucous membrane herniates through the defect and protrudes toward the serosa. It is also evident in the illustrations that the opening into the pouch is smaller than the fundus. Thus, it is a simple matter for fecal debris to be retained in these pouches. As infection occurs, the diverticula may rupture and form an intramural abscess, as shown in Figure 6. Figure 7 demonstrates a complete perforation through the serosa by an infected diverticulum. It is rather surprising that this does not happen more often. As the infection continues and spreads it may cause the formation of a fistula with an adjacent viscus, such as the urinary bladder or small intestine.

The roentgen findings are illustrated in Figures 8 and 9. It can be seen that as infection spreads along the wall of the sigmoid colon the roentgen picture becomes one of persistent spasm and deformity. Occasionally distortion is so marked that the findings are similar to those of carcinoma. This is evident in Figure 10.

From these observations one would expect that the presenting symptoms should consist of abdominal pain, fever and rectal bleeding; and that the abdomen in its lower quadrants would be tender and spastic to the examining hand, with an occasional palpable mass in the left iliac and lumbar areas. Such were essentially the symptoms and findings in our cases. Between 1946 and 1955 there were sixty-five cases

FIG. 3. Gross appearance. Longitudinal section of sigmoidal diverticulitis. Note thickening of intestinal wall.

of sigmoidal diverticulitis. Table I shows the age groupings, sex and the operations performed on these patients. There were thirty-one males and thirty-four females. Thirty of the patients (46 per cent) were more than seventy years of age. A total of fourteen operations was performed: eight colostomies and six resections of the sigmoid colon. Table II outlines the character and duration of symptoms in these patients. We especially wish to stress the fact that fifteen of the sixty-five patients (23 per cent) had symptoms for more than five years, and that twelve had symptoms more than one years. Abdominal pain, usually in the lower quadrants, was present in all but two. Rectal bleeding occurred in eighteen patients. Eighty per cent had tenderness in the left lower quadrant of the abdomen and 20 per cent had a palpable mass.

The six patients who were treated by sigmoid resection were all less than sixty years of age. There was no mortality in this group. During the past eighteen months I have performed primary resection and anastomosis for early diverticulitis in three patients who had persistent symptoms and specific roentgen findings but who did not have the advanced degree of disease, such as obstruction and fistula formation, which were once considered essential for surgical treatment. Eight patients underwent colostomy only. One man, seventy-one years old, had his colostomy closed during the early years of this series under the mistaken impression held by the supervising surgeon that the disease had been arrested. Colostomy had to be re-established three months later because of the return of symptoms. Another male patient, seventy-nine years of age, with symptoms for more than twenty years, underwent transverse colostomy which apparently precipitated a psychosis.

There were two deaths. One occurred in a seventy-five year old man who was admitted to the hospital with a twelve-hour history of generalized abdominal pain and vomiting. It was known that he had diverticulitis for at least

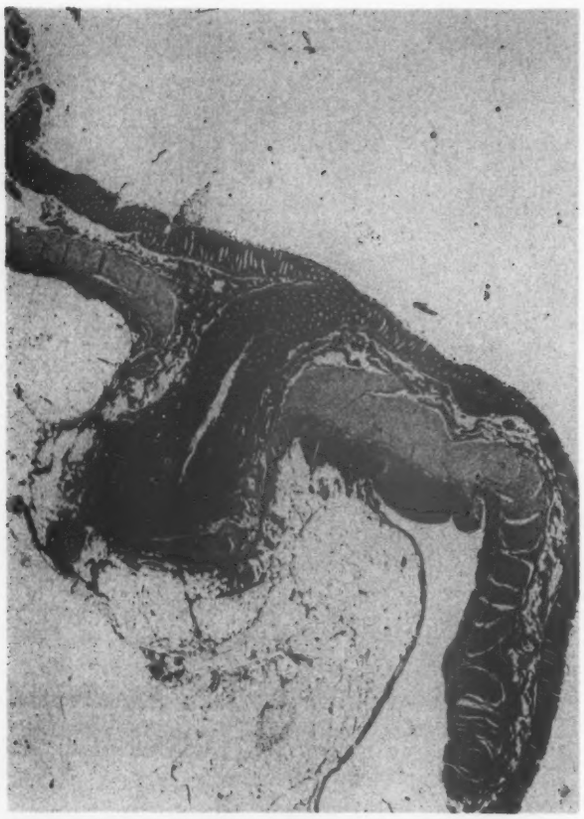

FIG. 4. Photomicrograph showing the fragmentation of the muscular coat and herniation of a diverticulum toward the serosa.

seven years, with frequent attacks of abdominal pain during that period. His condition was precarious on admission and in spite of all efforts to prepare him for operation he died as a result of an overwhelming peritonitis and electrolyte imbalance. Autopsy showed a generalized peritonitis due to perforated diverticulitis of the sigmoid, and pneumonia. The second death occurred in an eighty-one year old woman with a seven-hour history of lower abdominal pain. Operation consisted of the establishment of a transverse colostomy and drainage for a perforated sigmoid diverticulitis. Death occurred on the twenty-second postoperative day from pulmonary embolus and bronchopneumonia.

The technics of colostomy and resection of the colon have been adequately described in numerous monographs on colonic surgery and do not warrant extensive repetition here. In early elective cases we prefer resection of the involved bowel and adjacent infected mesentery and open end-to-end anastomosis by the two-layer technic of suture. It is most important that bowel ends be accurately approximated without tension. In instances of scattered diverticula throughout the colon only the inflamed area, usually in the sigmoid, requires resection. Complementary colostomy is indicated only when there is doubt as to the integrity of the anastomosis.

On the other hand, advanced cases showing the complications of abscess, fistula and obstruction require the usual preliminary colostomy and/or drainage before resection can be effected. Only resection can permanently halt the progress of this disease and should be done within four weeks following the establishment

TABLE I

	No.
Sex	
Males	31
Females	34
Age (in decades)	
30–39	2
40–49	2
50–59	12
60–69	19
70–79	25
80–90	5
Operations	
Colostomy	8
Resection	6

TABLE II

Symptoms	No.
Duration:	
Less than 1 yr.	37
1–5 yr.	12
5 yr. plus	15
Unknown	1
Character of symptoms:	
Generalized abdominal pain	63
Lower abdominal pain	38
Rectal bleeding	18
Vomiting	10
Diarrhea	13
Weight loss	6

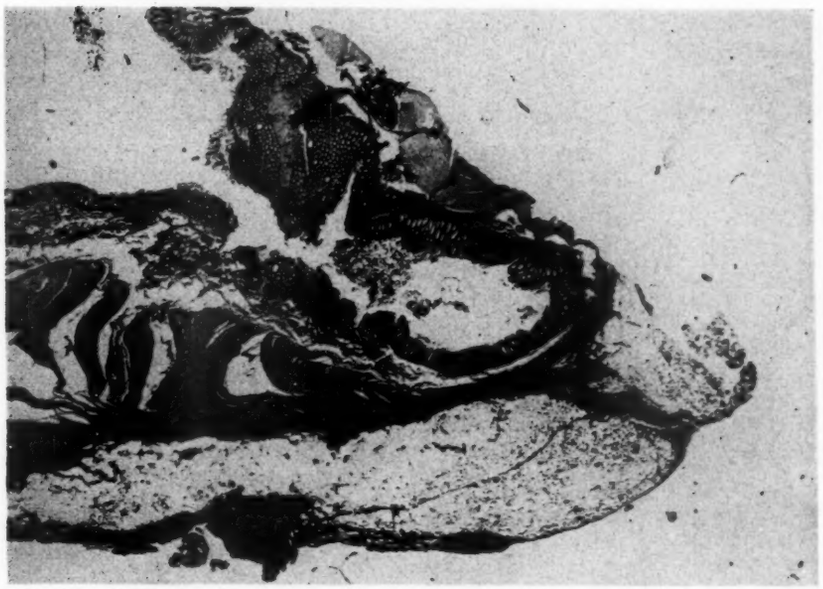

FIG. 5. Photomicrograph of cross section of diverticulum.

FIG. 6. Photomicrograph showing abscess formation in serosa secondary to ruptured diverticulum (diverticulitis).

of the colostomy. Longer delay is not necessary, especially since an incidental carcinoma may be present. The preparation of the patient for operation entails the correction of electrolyte, protein and blood deficiencies. We prefer the administration of 4 gm. of sulfathalidine® a day for five days before laparotomy.

COMMENTS

A review of our patients shows that 23 per cent had symptoms of sigmoidal diverticulitis for more than five years, and that thirty (46 per cent) were more than seventy years of age. It is evident that this is an inflammatory disease which tends to become chronic and to increase in severity during the course of the years. The advanced complications which result from it are such as to make late surgical treatment both difficult and hazardous, since the only definitive procedure is resection of the diseased segment of colon. On the other hand, resection of a sigmoid colon involved with diverticulitis in its

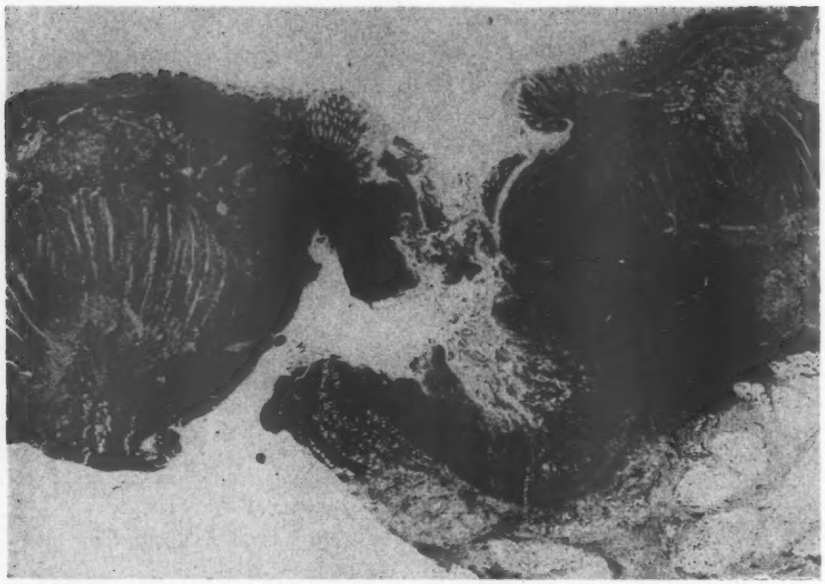

FIG. 7. Photomicrograph showing complete perforation of intestinal wall secondary to diverticulitis.

FIG. 8. Roentgen appearance in diverticulosis.

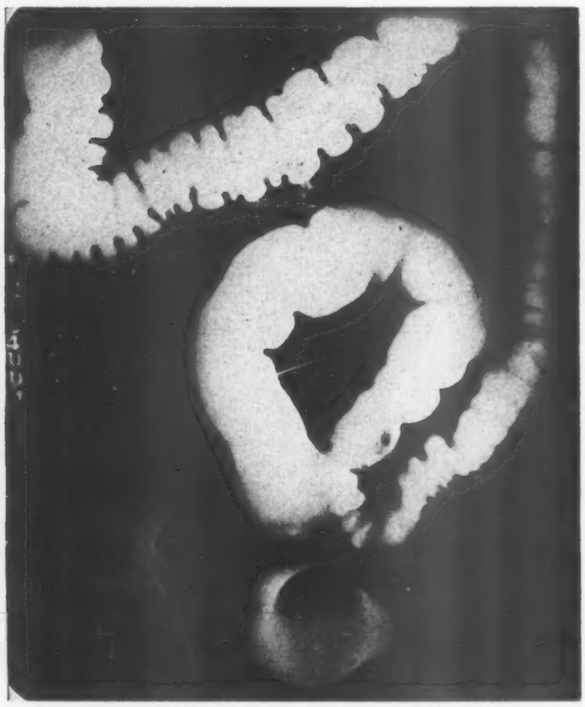

FIG. 9. Roentgen appearance of sigmoidal diverticulitis. Note spasm and deformity of sigmoid colon.

early phases carries with it a low morbidity and mortality [3,8]. It is, therefore, obvious that elective resection in early cases is a preferable mode of treatment.

In order to select properly the patients suitable for early operation it is suggested that the following criteria be used. The patient should give a definite history of the disease supported by specific physical signs in the lower quadrant of the abdomen. In addition, roentgen study should show not only diverticula but also the persistent spasm and deformity of the sig-

moid indicative of an inflammatory process. The patient should also give the specific history of more than one attack. Rectal bleeding is an additional and important indication for early operation. Of course, the patient's general condition must be such as to allow the performance of major resection of the bowel. This is especially important in individuals past the age of seventy who may have general arteriosclerotic disease and/or evidence of electrolyte and protein depletion. If such deficiencies can be improved or corrected, primary resection on an elective basis should be considered even in elderly patients.

SUMMARY

1. The clinical course, roentgen findings and pathologic picture of sigmoidal diverticulitis have been reviewed.
2. Sixty-five cases of sigmoidal diverticulitis were studied.
3. It is evident that sigmoidal diverticulitis may become chronic and more severe with each attack.
4. Twenty-three per cent of the patients studied had symptoms for more than five years, and forty-six per cent were more than seventy years old.
5. Elective resection of the sigmoid colon for diverticulitis is recommended in early cases before the development of complications.
6. Criteria have been suggested for the selection of patients for this procedure.

FIG. 10. Roentgen appearance in more advanced sigmoidal diverticulitis. Marked deformity of sigmoid colon.

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Primary Reticulum Cell Sarcoma of Bone

A PRESENTATION OF FIVE CASES

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IN recent years an increasing number of papers have been presented on primary reticulum sarcoma of bone, recognizing it as a distinct entity, one differentiated from Ewing's sarcoma of bone and other major bone lesions.

The specific diagnostic term "reticulosarcoma" was first introduced by Oberling [9] in 1928. In 1932 Oberling and Raileanu [10] were the first to explain the histogenesis of tumors previously considered to be of the Ewing's type.

Later, in 1939, Parker and Jackson [11] popularized the entity "primary reticulum sarcoma of bone" when they described seventeen cases drawn mainly from the Bone Tumor Registry. Subsequently, series of cases were

1 2

FIG. 1. Case 1. Anteroposterior view of proximal third of tibia discloses irregular areas of cortical destruction without definable limits.

FIG. 2. Case 1. Lateral view of Figure 1.

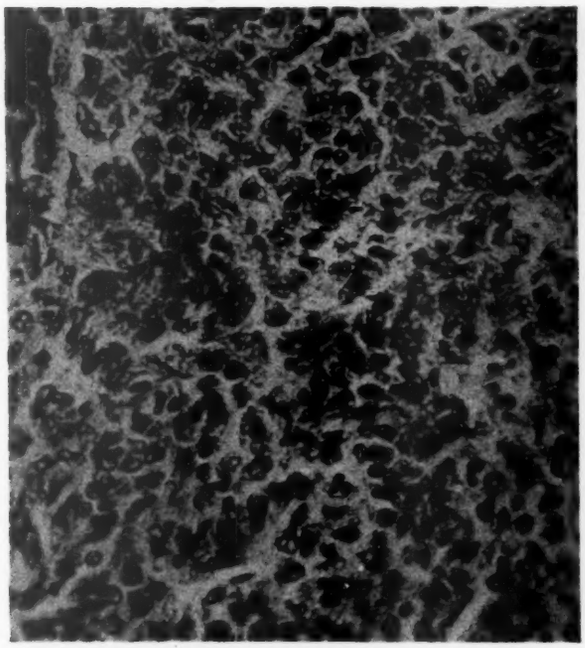


FIG. 3. Case I. High power photomicrograph of tumor cells. Large round and oval cells with hyperchromatic nuclear staining with tendency to form small groups.

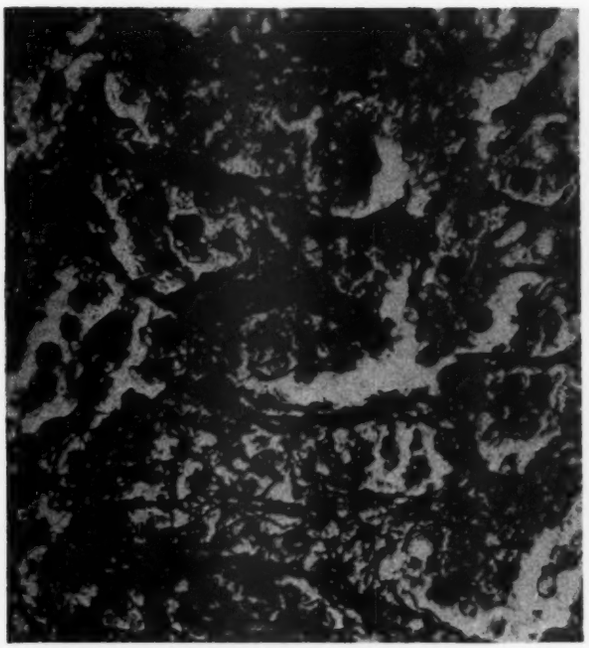


FIG. 4. Case I. High power photomicrograph, reticulum stain. Abundant reticulin fibers circumscribing small groups of tumor cells. The presence of a dense lattice reticulin structure aids in distinguishing the primary reticulum cell sarcoma of bone from a Ewing's tumor. (See text.)

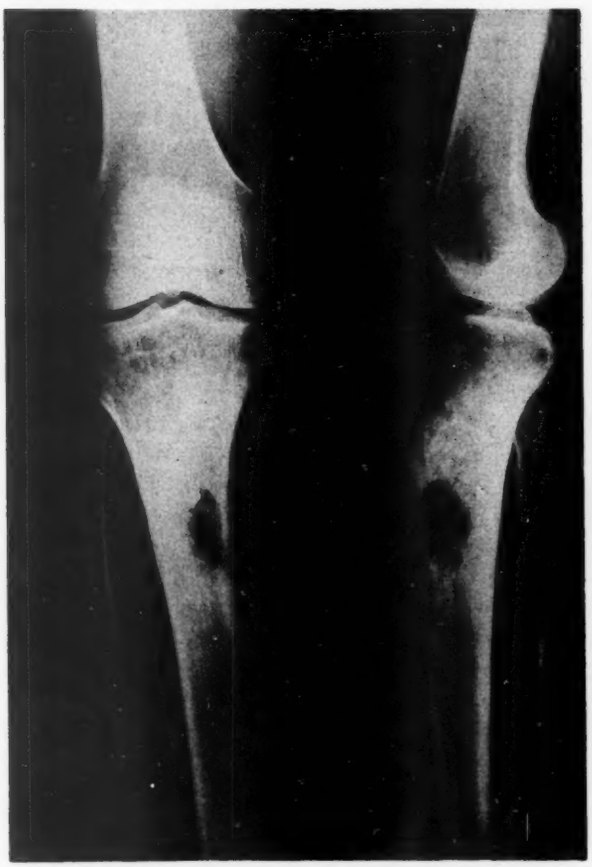


FIG. 5. Case I. X-ray taken thirty months following radiation. Note area of biopsy with surrounding area of increased cortical density and bone regeneration.

FIG. 6. Case II. Anteroposterior and lateral views of distal tibial metaphysis discloses a small area of rarefaction in medullary cavity.

FIG. 7. Case 11. High power photomicrograph disclosing dark-staining nuclei of round and ovoid cells grouped in small clusters.

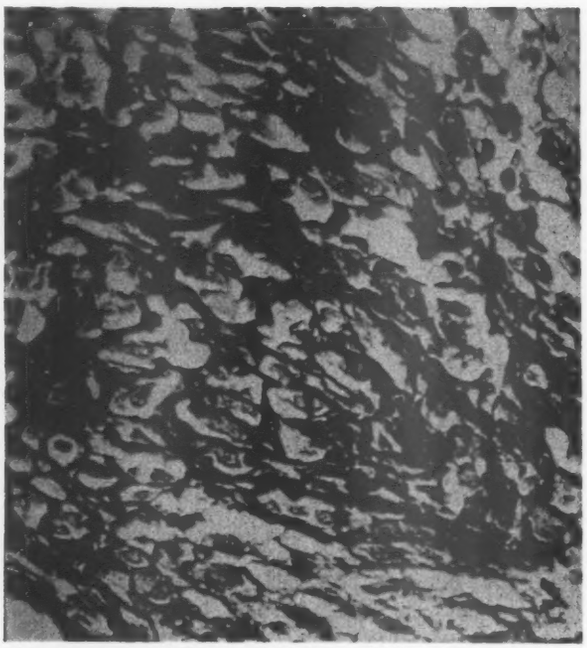
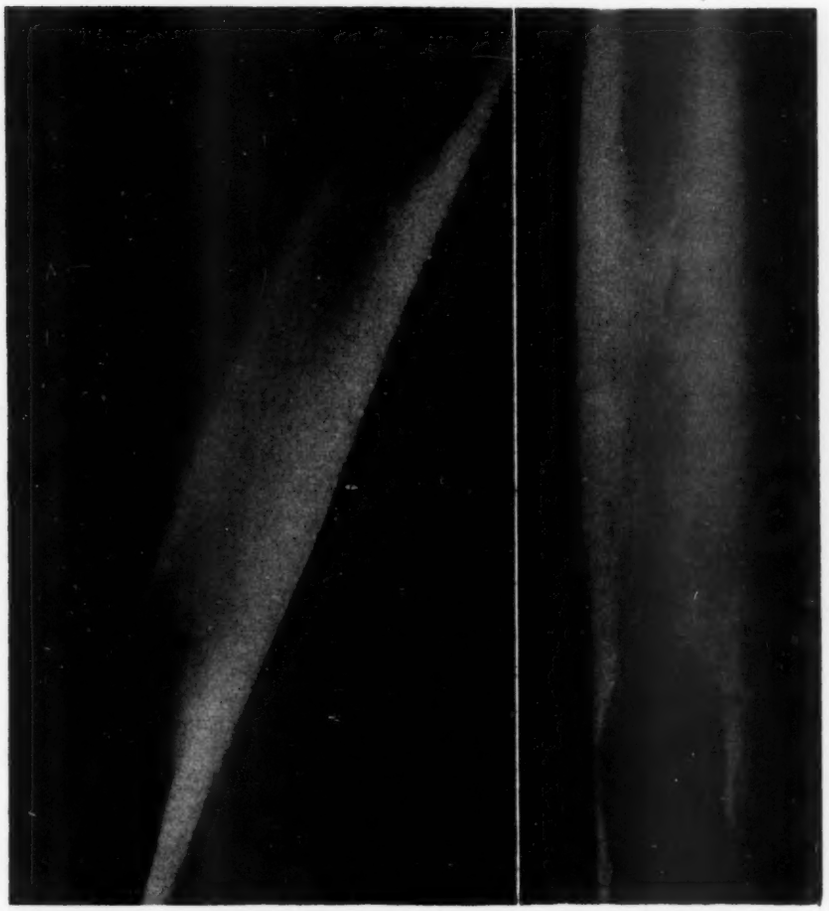


FIG. 8. Case 11. High power photomicrograph, reticulum stain; reticulin fibers forming septa around individual and small groups of cells.

FIG. 9. Case 11. X-ray following radiation showing increased density and epiphyseal cartilage plate irregularity.

reported from Memorial Hospital in New York [*1,2*], the Mayo Clinic [*4,8*] and other sources [*5,12,13*]. These reports all supported the contention that this tumor is a distinct entity. There have also been exceptions to this contention, notably an English report [*7*] as late as 1956, which disputes its separate classification from that of Ewing's sarcoma of bone.

Over a forty-seven-year period the Mayo Clinic has collected 2,000 specimens of primary bone tumors. Of these, forty-nine (less than 2.5 per cent) were classified as primary reticulum cell sarcoma. During the same period eighty cases of Ewing's tumors were observed [*4,8*]. The cases of primary malignant bone tumors presented by Memorial Hospital in New York [*1,2*] over a fifteen-year period revealed an incidence of primary reticulum cell sarcoma of 5 per cent. More than half of these patients were under forty years of age, with males predominating in a ratio of 3:1. Over half of the lesions were found in the pelvis or the lower extremities and 70 per cent were in the tubular bones. Significantly, the survival rate for patients with primary reticulum cell sarcoma of bone with treatment is reported as about 33 per cent over a ten-year period [*2*], whereas the reported survival rate for those with Ewing's tumor is only from 2 to 3 per cent over a five-year period.



10 11

FIG. 10. Case III. Lateral view. Posterior cortex reveals moderate sclerosis. The medullary cavity discloses some scalloping on the margin of the anterior cortex.

FIG. 11. Case III. Anteroposterior view. Cortical sclerosis and scalloping are present on both cortices.

Five cases of primary reticulum cell sarcoma of bone are presented herein and added to the literature, supporting the contention that its total evaluation—roentgenologic, pathologic and more favorable clinical course—merits its recognition as a separate entity.

A constant presenting symptom in cases of primary reticulum sarcoma is moderate pain, which may last for a year or less before the patient seeks medical attention. An important feature is the comparative well-being of the patient in the presence of relatively large bone lesions in contradistinction to the chronic low grade fever, fatiguability and loss of weight associated with malignant bone tumors and the generalized form of reticulum cell sarcoma.

Although there are no specific x-ray findings for primary reticulum sarcoma of bone, destruction with a mottled, patchy appearance is a usual finding in early cases. The lesion is medullary in origin, often with poorly defined margins. Cortical destruction varies from fine, irregular areas to wide sections of erosion. The cortex is not expanded nor is periosteal reaction a prominent feature. Soft tissue involvement is found in three-fourths of the cases [*14*].

There is general agreement among pathologists [*4,6,11*] that the cell of origin is the reticulum cell, its histologic appearance being indistinguishable from the generalized form. The cell is about two times as large as a lymphocyte with an indented or lobulated nucleus and variable hyperchromatism. The reticulum network contains isolated or small groups of tumor cells, as contrasted to Ewing's sarcoma where, according to some observers [*3,4,11–13*], the reticulum fibers circumscribe larger areas of tumor cells.

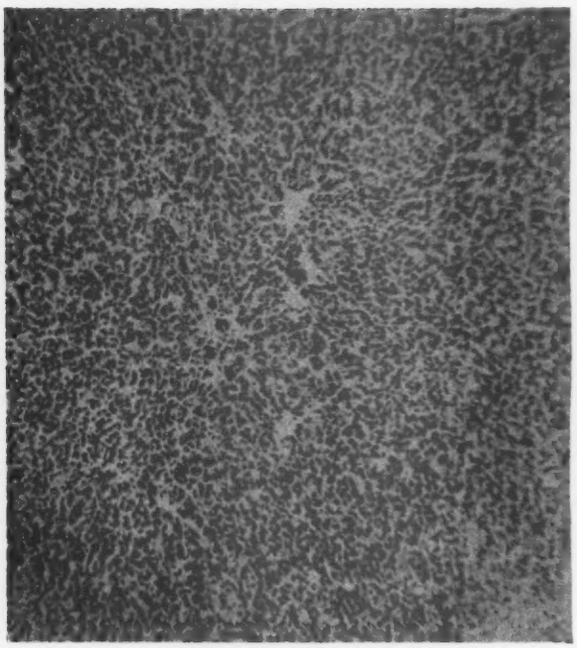


FIG. 12. Case III. Low power photomicrograph discloses a sheet of round and ovoid cells. The uniform pattern and histologic picture seen in primary reticulum cell sarcoma of bone cannot be differentiated from the reticulum cell sarcomas arising in lymphoid tissues.

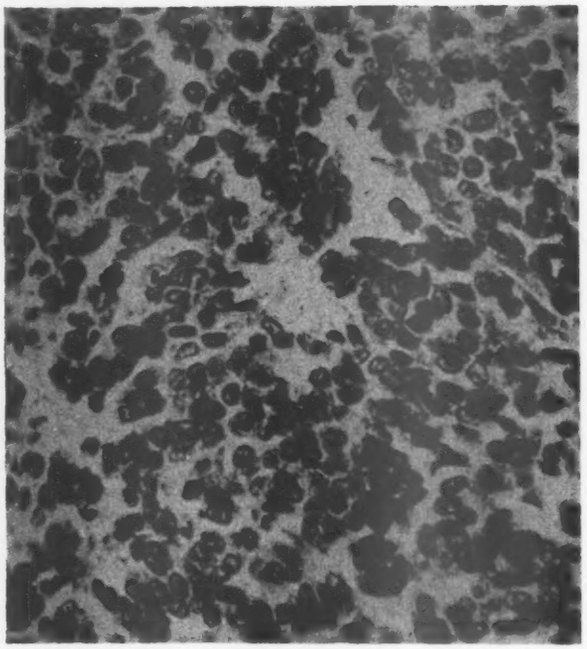


FIG. 13. Case III. High power photomicrograph. Cells present are round, lobular and vesicular, with scattered smaller cells with hyperchromatic nuclei.

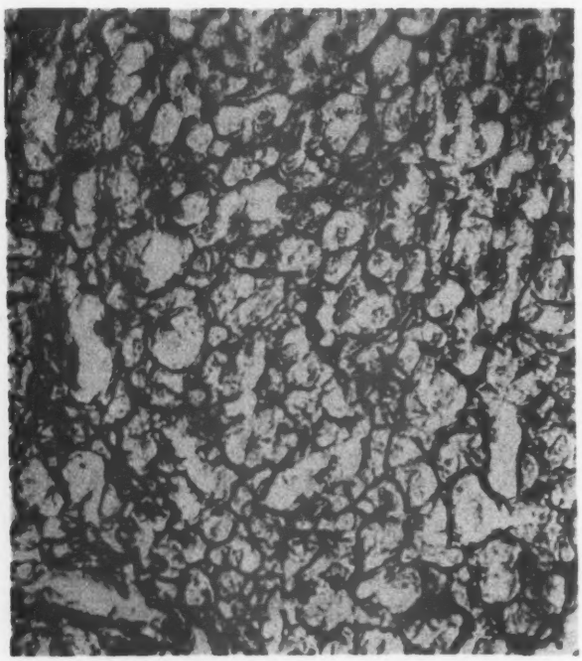


FIG. 14. Case III. High power photomicrograph, reticulum stain, disclosing many reticulin septa.

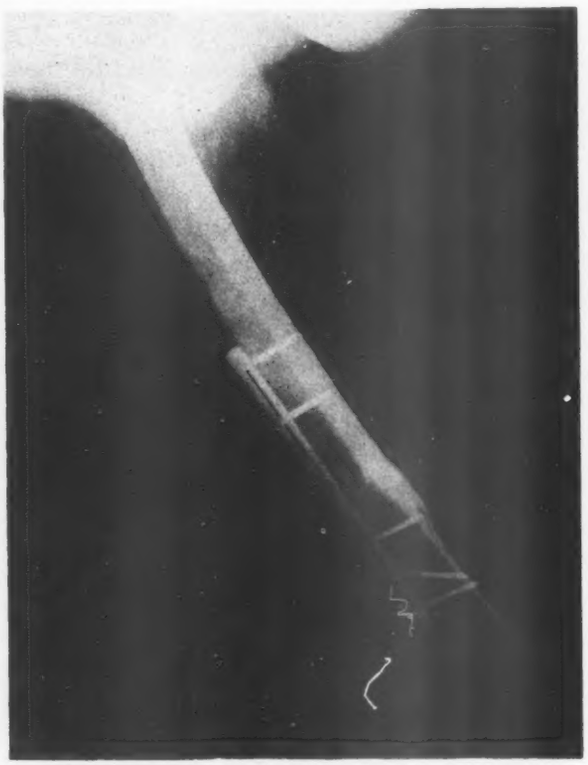


FIG. 15. Case III. X-ray showing reduction and internal fixation. Marked sclerosis of posterior cortex proximal to fracture.

FIG. 16. Case III. Low power photomicrograph shows viable bone present.

FIG. 17. Case III. High power photomicrograph shows dense fibrous tissue with no evidence of tumor cells.

CASE REPORTS

CASE I. S. S., a forty-six year old white man, reported a sudden onset of pain in the proximal third of his right leg of three months' duration. Examination disclosed a small nodule over the proximal third of the tibia. There was no regional or generalized lymphadeno athy. His general health was good. The x-ray revealed a mottled and patchy osteolytic tumor in the proximal third of the tibia, with a cortical defect present anteriorly. (Figs. 1 and 2.) Bone biopsy revealed a granulomatous tumor mass overlying lytic areas in the tibial cortex. On microscopic examination a sheet of tumor cells was seen with low power. On high power field, large round and oval cells with hyperchromatic nuclear staining were present. There were a moderate number of mitotic figures. (Fig. 3.) The reticulum stain showed small groups and individual cells circumscribed by abundant reticulin fibers. (Fig. 4.) The patient was treated with 10 mg. of tri-ethylmelamene and radiation (totalling 4,500 r in air). It is now thirty months since therapy and the patient is living and well. A recent x-ray shows the previous area of biopsy, regeneration of bone and increased cortical density. (Fig. 5.)

CASE II. A. K., a five year old boy, had intermittent pain in the left ankle of ten months' duration. Examination revealed moderate edema of the lower third of the left leg with slight heat. No redness of overlying skin or lymphadenopathy was found. X-ray disclosed a small area of rarefaction in the distal medullary cavity. (Fig. 6.) A biopsy disclosed cellular material on the cortex and medullary canal. On microscopic examination the same proliferation of cells was seen. Higher power showed the round and ovoid cells with hyperchromatic nuclei. (Fig. 7.) Some mitotic figures were present. The reticulum cell stain again showed the small groups of cells surrounded by reticulin fibers. (Fig. 8.) The patient was treated with radiation, high voltage technic, with an estimated tumor dose of 5,000 r. A recent x-ray disclosed increased cortical density as well as some apparent epiphyseal damage. (Fig. 9.) The patient is now living and well eighteen months following therapy.

CASE III. K. L., an eleven year old boy, had pain in the right thigh which had been intermittent for about four years and was associated with low grade fever. Previous x-rays were said to have been negative. Examination disclosed local tenderness and warmth about the mid-thigh. No regional or distant lymphadenopathy was present. An x-ray of the area revealed sclerosis of the posterior cortex, some scalloping within the medullary canal,

18 19

FIG. 18. Case IV. Anteroposterior view shows diffuse rarefaction of cortex with scalloping along medullary cavity.

FIG. 19. Case IV. Lateral view discloses some subperiosteal new bone formation.

with some rarefaction within the sclerotic cortex. (Figs. 10 and 11.) On the basis of a diagnosis of a low grade osteomyelitis, saucerization of the femur was performed. The marrow cavity was filled with what was thought to be granulation tissue. The microscopic examination showed a sheet of round and ovoid cells as in other cases. (Fig. 12.) On higher power, variable nuclear staining with a moderate number of mitotic figures was seen. (Fig. 13.) The reticulin stain again showed individual cells and groups of cells circumscribed by an abundant reticular network. (Fig. 14.) The patient was treated with radiation consisting of two anterior and two posterior fields of 1,500 r per field. He was perfectly well until eighteen months later when he was readmitted with a fracture of the right femur which he sustained after a fall in a ball game. Examination disclosed no regional or distant lymphadenopathy. Chest x-ray and skeletal survey were normal. X-ray of the femur disclosed increased density of the bone proximal to the fracture and rarefaction of bone distally. (Fig. 15.) An open reduction and fixation provided an opportunity for a "second look." There was yellow, gelatinous material which was also present in the adjacent muscle. On microscopic examination no evidence of tumor tissue was present. The bone was viable. (Fig. 16.) Dense, hyalinizing, fibrous tissue was present in other areas. (Fig. 17.)

CASE IV. J. P., a twenty-six year old white man, had intermittent pain in the left thigh of one year's duration. Examination disclosed

some atrophy of the extremity and moderate tenderness over the mid-thigh. There was a suggestion of a deep mass adherent to the bone at this level. No regional or generalized lymphadenopathy was present. X-ray of the area revealed some rarefaction of the cortex with scalloping within the medullary cavity. (Fig. 18.) The lateral view also showed some subperiosteal new bone formation. (Fig. 19.) Microscopic examination of a biopsy specimen revealed a cellular pattern similar to the preceding figures. (Fig. 20.) Based upon the original diagnosis of Ewing's sarcoma, a hip disarticulation was done. The patient is now living and well without evidence of recurrence eight years following surgery.

CASE V. This patient, a fifty-one year old white woman, had intermittent pain in the right leg of eight months' duration. X-rays taken during this interval had been reported as negative. There were no constitutional symptoms. Examination disclosed a localized swelling over the anterolateral aspect of the right leg which was moderately tender. No regional or generalized lymphadenopathy was present. On x-ray an area of rarefaction in the anterolateral aspect at the proximal end of the tibia was seen. A soft tissue mass was present associated with some erosion and periosteal reaction around the fibula. A cloacal defect of the posterior aspect of the tibia was present. (Fig. 21.) A biopsy specimen from the tibia revealed sheets of tumor cells which were round, ovoid, and in general had the same characteristic cytologic appearance as the preceding figures. (Fig. 22.) The patient was given radiation therapy, a total of 4,600 r to the area, with relief of pain and eradication of the soft tissue mass. She was readmitted five months following radiation with pulmonary metastasis and pleural effusion.

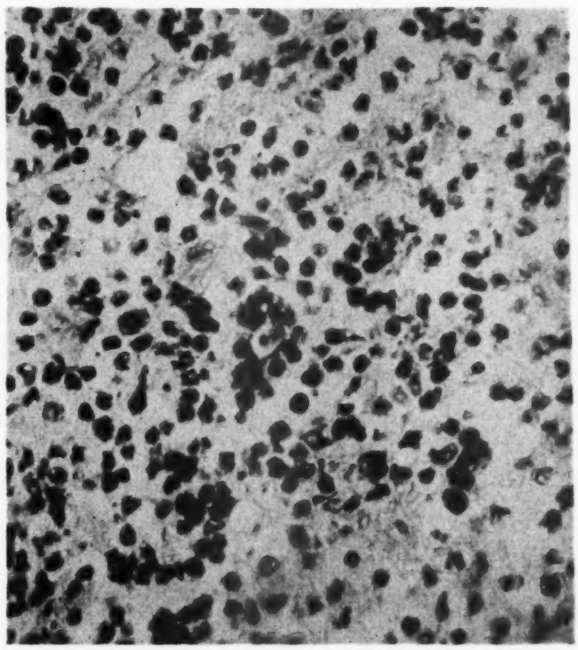


FIG. 20. Case IV. High power photomicrograph shows round and ovoid cells with a tendency to small clusters.

OBSERVATIONS

A differential diagnosis of primary reticulum cell sarcoma is often a difficult one to make. The tumor can easily be confused with other bone lesions such as Ewing's tumor, metastatic neuroblastoma, osteomyelitis and the osteolytic type of osteogenic sarcoma. Certain guideposts can be marked to help make the differential diagnosis.

Ewing's tumor, in general, has an earlier onset, involving the younger age group from eight to sixteen. Initial x-ray changes of cortical condensation or periosteal and endosteal proliferation are followed by osteolytic changes. The patient's general condition is seriously affected and a febrile reaction is often present. Metastases to the lungs and other bones are frequent and occur early with a fatal course in nearly all cases.

Metastatic neuroblastomas are also more commonly found in infants and young children, although occasional instances have been reported in adults. In the cytology of this tumor the diagnostic point of great significance is the finding of tumor cells arranged in rosettes. The clinical course of metastatic neuroblastoma has the same poor prognosis as Ewing's tumor.

The osteolytic type of osteogenic sarcoma shows on x-ray a greater frequency of periosteal thickening and calcification of periosseous tumor masses. There is a lesser degree of cortical destruction and medullary growth in this tumor and it is relatively radioresistant.

COMMENTS

The more favorable prognosis and response of primary reticulum cell sarcoma to local radiation merits its differentiation from other primary malignant bone lesions.

FIG. 21. Case v. Anteroposterior and lateral views. Area of rarefaction in anterolateral aspect of proximal tibia associated with a soft tissue mass. A cortical defect in tibia is seen posteriorly. There is erosion below the neck of the fibula.

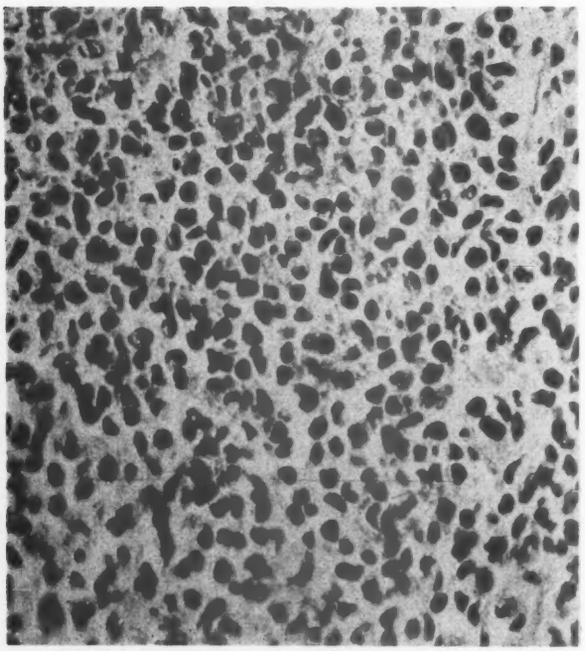


FIG. 22. Case v. High power photomicrograph. Round cell tumor is similar in microscopic appearance to preceeding slides.

The differential diagnosis is not an easy one to make. The roentogenologic appearance is not pathognomonic but may merely suggest the pathologic condition present. The clinical picture is equally non-specific. However, with the aid of a pathologist who has had exceptional experience with diseases of bone, a differential diagnosis can be made. The total picture is significant, especially the lack of systemic findings. To make way for this more favorable prognosis, it is important to evaluate critically all pathologic, roentgenologic and clinical findings and so differentiate primary reticulum cell sarcoma of the bone from Ewing's tumor, metastatic neuroblastoma and other malignant bone lesions.

SUMMARY

Five cases of reticulum cell sarcoma of bone have been presented. Primary reticulum cell sarcoma of bone is accepted as a separate entity. The more favorable prognosis of reticulum cell sarcoma of bone as compared to Ewing's tumor justifies its identity on more than a mere academic basis. To make this often difficult differential diagnosis, the assistance of a pathologist with wide experience in diseases of bone is essential.

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A Practical Approach to the Management of Delayed Union and Non-union of the Long Bones

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THE problem of delayed or non-union of the long bones confronted the Orthopedic Surgery Staff at Parks Air Force Base Hospital, California, on fifty occasions during the years 1954 through 1956. Twelve occurred in fractures initially treated at this hospital, and thirty-seven cases were referred from other hospitals. An analysis of these cases from the standpoint of a practical approach to the management of delayed union and non-union is the purpose of this article. Although etiology will not be discussed thoroughly, it should be stated that these conditions generally result from a combination of two factors, namely, the severity of the initial injury and its mode of treatment. Whereas the first factor is circumstantial and therefore medically uncontrollable, the second lies within the realm of the surgeon's judgment. Too frequently, abuse of the latter is directly responsible for the complication.

Definition of Terms. Delayed union: A status that exists when in the surgeon's judgment healing has not progressed at a rate expected for the location and fracture type, and further delay in definitive treatment probably would result in non-union. Arbitrarily, the normal healing processes should be well advanced at three to four months in the upper extremity and six to nine months in the lower extremity.

Non-union: The healing process has stopped short of bony union and false motion is present. A bony defect, sclerosis or porosis, rounding and mushrooming of the bone ends and blockage of the intramedullary canal may be seen on roentgenogram.

GENERAL PRINCIPLES

Since no fixed concept is applicable to all situations, the plan of treatment must be chosen and properly executed only after careful consideration of all involved factors in each case. The following general principles, selected largely from the writings of Abbott [*1*], Albee [*2*], Bickel [*4*], Boyd [*6*], Campbell [*7*], D'Aubigne [*9*], Horowitz and Lambert [*11*], Phemister [*14*], Speed [*17*] and Urist et al. [*18*], should be observed in the management of any delayed union or non-union.

General Condition. Poor systemic conditions such as malnutrition, anemia and hypoproteinemia should be overcome.

Local Status of Soft Tissues. Due to the severity of the original injury, previous surgical procedures and prolonged plaster immobilization, the circulatory status of the extremity is not optimal for surgery. Thus removal of plaster, followed by active function and indicated physiotherapy for a time prior to the definitive procedure, serves to enhance local blood supply. A daily pHisoHex® scrub for one week to ten days prior to the surgery serves as an efficient mechanical skin cleanser. Postoperative infections are thereby reduced. Concomitant nerve injury should be evaluated and repaired if feasible prior to the bone work.

Infection. Associated infection poses a major problem. Every attempt should be made to eradicate the source of infection by sinus excision, removal of metallic foreign bodies and sequestrectomy. At least four to six months should elapse between the cessation of drainage and reconstructive bone surgery. Horowitz and Lambert [*11*] have observed positive cultures at operation six to twelve months after the cessation of drainage in 50 per cent of their cases.

Skin Defect or Adherent Scar. Restoration of adequate full-thickness skin coverage is an essential prerequisite to the bone procedure.

This may be accomplished after drainage is quiescent for at least six weeks by local pedicle, cross leg flap or tube pedicle from a distance. An adherent scar, the site of previous infection, should be avoided and exposure made through an alternate approach. Adjacent parallel incisions over the anterior surface of the tibia must be avoided as they inevitably cause necrosis of the intervening skin.

Bone-Grafting Technic. Campbell [7] enumerated the fundamental dicta of bone graft surgery when he observed that three factors are of primary consideration in the management of non-union, namely, accurate reduction and apposition of fragments, internal fixation and an osteogenesis factor. He favored the use of a massive cortical bone graft transfixed by screws. In more recent work Abbott [1] has demonstrated that cortical bone offers only limited osteogenic power compared with cancellous iliac bone. His studies have also shown that in marked contrast to cortical bone the cancellous variety has a remarkable propensity for survival in the face of infection. Minimal trauma at surgery provides less chance for reactivation of infection. Metallic foreign bodies should be kept to a minimum or eliminated where the danger of recurrence of infection is paramount. A smooth bed should be prepared for the graft to provide firm contact between the host fragments and the osteogenic inductor. For most effective results the graft should be long enough to bridge well above and below the site of non-union. Only autogenous tibial and iliac bone were employed in the present series. Through the use of any properly planned and executed method, union may be anticipated in most instances following the proper passage of time. Infection comprises the major obstacle to this rule. The treatment of choice in every instance is the simplest one compatible with a successful result.

Aftercare. Rigid, efficient and continuous immobilization must be maintained until bony union is well advanced. A well fitting ischial weight-bearing brace or plaster walking cast can be used to advantage at the discretion of the surgeon in cases involving the tibia or femur when union has progressed but lacks the solidity necessary for unsupported weight bearing. This often speeds the process of bony union and aids rehabilitation.

TABLE I
INCIDENCE IN THIS SERIES

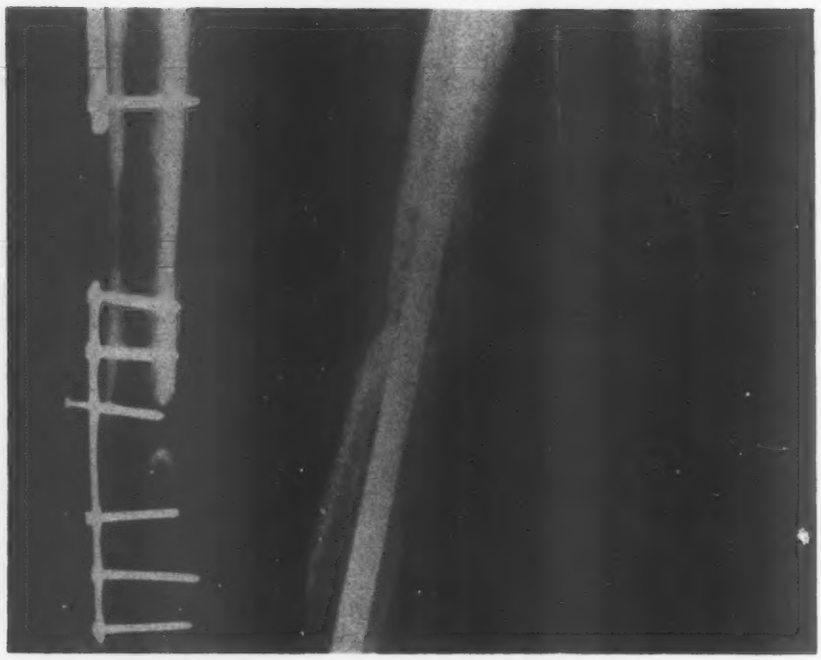
Site	Delayed Union	Non-union
Humerus	3	6
Ulna	3	5
Radius	2	2
Femur	5	9
Tibia	8	7

ANALYSIS OF CASES IN THIS SERIES

Fifty cases of delayed or non-union were observed at Parks Air Force Base Hospital during the years 1954 through 1956. (Table I.) These were managed by a variety of methods (Table II), which produced solid bony union in forty-seven cases and failure in three. Twenty-three fractures were initially compound. Although eleven of these presented drainage for

TABLE II

Site	Iliac Inlay or Onlay without Internal Fixation	Iliac Onlay plus Screws or Intramedullary Fixation	Single or Dual Tibial Grafts with Screw Fixation	Onlay Iliac plus Screw or Plate Fixation of the Non-union	Metallic Fixation Device Only	Full-Thickness Cross Leg Skin Flap Only	Ischial Brace Only
Humerus	1	5	3	..	..	..	..
Ulna	1	6	..	..	..	..	..
Radius	1	1	1	1	1	..	..
Femur	4	7	1	..	1	..	1
Tibia	6	2	1	1	2	1	2
Totals	13	21	6	2	4	1	3



1A 1B

FIG. 1. (Case I.) A and B, non-union of the mid-shaft of the femur well healed five months after treatment by a clover leaf intramedullary nail and autogenous iliac strip grafts. Unsupported weight bearing was begun two weeks after surgery.

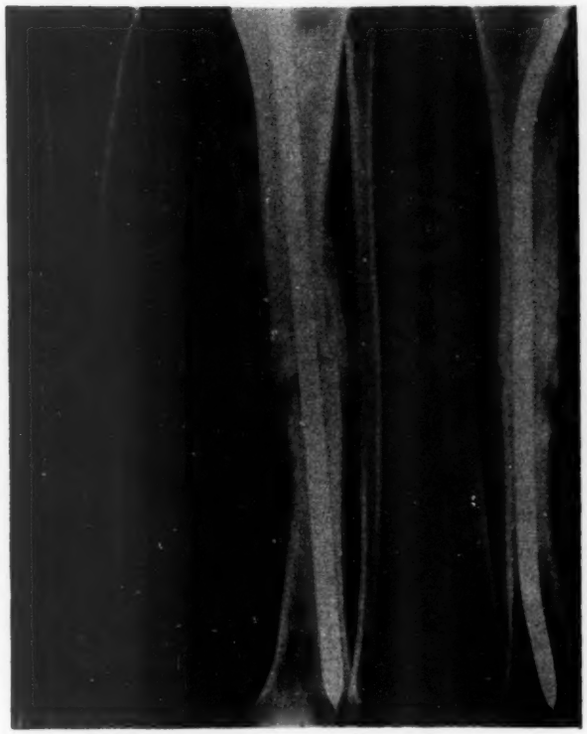
a time preoperatively, none were draining at the time of bone graft surgery. Five of the latter, including two failures, drained briefly after operation. In one instance (Case IX), in spite of solid bony union, there was still slight drainage (one drop per day) at the time of hospital discharge. Two instances of superficial wound infection, which arose in previously simple fractures, healed readily with antibiotic therapy. The unsuccessful result in two cases was due to recurrence of massive infection. The third failure occurred in an olecranon with long-standing non-union which was treated by a long intramedullary screw and double onlay iliac grafts. The original injury in the latter had restricted elbow motion severely (flexion to 85 degrees, extension to 135 degrees). Although the grafts were united to the ulna three months postoperatively when plaster fixation was discontinued, they progressively melted away with resumption of motion. The long distal lever arm working against a restricted range of motion was considered responsible for this failure. Perhaps more prolonged immobilization would have allowed solid healing across the site of non-union. Asymptomatic fibrous union resulted in this case.

CHOICE OF METHOD, AND ILLUSTRATIVE CASES

Intramedullary Nailing Combined with Iliac Onlay Grafts

This method is most efficiently employed in transverse or short oblique types involving the middle third of the femur or tibia. A well fitting nail permits partial weight bearing to begin soon after the operative reaction has subsided. The nail is less effective in the upper extremity as the stimulation of weight-bearing, an important factor for union with this method, cannot be utilized. However, due to the ease with which the ulna lends itself to intramedullary nail insertion, a nail combined with iliac strip grafts is the most practical method of dealing with this bone.

CASE I. W. O., a twenty-one year old airman, suffered a compound comminuted midshaft femoral fracture, further complicated by femoral neck and tibial plateau fractures on the same side in December, 1954. Initial treatment elsewhere consisted of open reduction and blade plate fixation of the femoral neck and open reduction with plate and screw fixation of the shaft. Non-union of the femoral shaft was present eleven months postinjury. (Fig.



2A 2B

FIG. 2. (Case II.) A and B, non-union of the tibial mid-shaft showing union five months after treatment by a Lottes nail and autogenous iliac strip grafts. Weight bearing in plaster was allowed one month after surgery. Support was discarded at the end of two months.

3A 3B

FIG. 3. (Case III.) A and B, delayed union of the tibial mid-shaft managed by the closed insertion of a clover leaf nail. Immediate unsupported weight bearing was permitted. Union was advanced three months later when the patient was returned to duty.

1A.) Union was attained by the use of an intramedullary nail and iliac strip grafts after removal of the original fixation devices. (Fig. 1B.) Full weight bearing was allowed two weeks after the definitive surgery.

CASE II. W. T., a twenty-one year old airman, sustained a closed mid-shaft tibial fracture in June, 1955, which was treated elsewhere by plaster fixation. Nine months later non-union was present. (Fig. 2A.) Union occurred after insertion of a Lottes nail and iliac strip grafts. A long-leg walking plaster was used for eight weeks prior to unsupported weight bearing. The patient was returned to duty five months postsurgery. (Fig. 2B.)

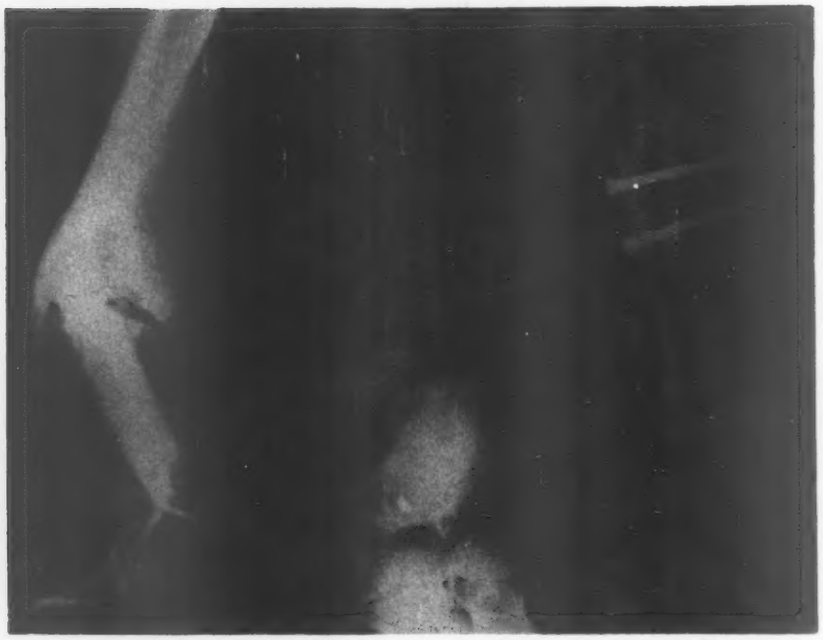
Closed Insertion of a Nail Alone

Where ideal conditions exist, namely, a transverse line of non-union in the middle third of the shaft of femur or tibia without malposition, closed insertion of an intramedullary nail, followed by weight bearing, can produce union.

CASE III. E. C., a twenty-seven year old sergeant, sustained bilateral tibial fractures in an automobile accident in March, 1955. Initial treatment of the right tibia (compound comminuted fracture) consisted of débridement and a Lottes nail. Closed plaster treatment was given for the left tibia. Eleven months post-injury, non-union was present on the left side. (Fig. 3A.) Because of the good alignment and mid-shaft position, a clover lead intramedullary nail was inserted via the closed technic. Immediate unsupported weight bearing was begun without pain. The patient was returned to duty in July, 1956, three months postsurgery. (Fig. 3B.)

Massive Double Onlay Tibial Graft Secured by Screws

This procedure provides sturdy internal fixation and a good osteogenic inductor. It is preferred for established non-union or pseudarthrosis in the humerus. The sclerotic ends are first resected and squared and the medullary



4A 4B

FIG. 4. (Case IV.) A and B, long-standing pseudarthrosis of the lower humeral shaft successfully managed by double onlay grafts (from the tibia) with screw fixation.

canal is opened. The forceps action of this method is particularly useful near a joint.

CASE IV. A. G., a thirty-four year old airman, was referred for treatment of pseudarthrosis of the distal left humerus of six years' duration. (Fig. 4A.) Three unsuccessful attempts, including two onlay grafts and an intramedullary nail with onlay grafts, had previously been made. A double onlay tibial graft fixed by six screws and assisted by cancellous chips was attempted. Plaster spica support was maintained for ten weeks. The patient was returned to duty five months postsurgery, with solid union. (Fig. 4B.)

Single Onlay Tibial Graft Fixed by Screws

This method, which affords a rigid internal strut and a satisfactory osteogenic stimulus, is generally preferred for the humerus and radius (Cases V and VI). A massive graft supplemented by iliac strips provides an excellent means of bridging large gaps. The graft must extend well above and below the non-union site. External plaster support is mandatory.

CASE V. W. D., A thirty-three year old officer, was referred in May, 1955, with non-union of the right humerus. Initial treatment of his fracture (July, 1954) had consisted of a hanging cast for six weeks followed by open reduction and fixation by a metal plate, screws and a primary iliac graft. After removal of the plate and screws, the non-union was managed with a long tibial graft fixed by six screws. Union was advanced ten weeks later when the plaster spica was discontinued. After a few months of light duty, he was returned to flying status.

CASE VI. In March, 1955, a twenty-one year old airman sustained a refracture through a drill hole of an old fracture of the radius. Three months later, after failure to control the fragments by closed methods, a tibial graft and screws were used for fixation of the delayed union. Solid healing was present when plaster was removed three months later.

Sliding Inlay Graft

This method is indicated in those non-unions, especially in the lower and upper third of the tibia, where adherent scars have reduced the tissue elasticity and have precluded the increase of bone volume necessary in onlay grafting. The addition of thin iliac strips further accelerates healing.

CASE VII. G. B., a twenty year old airman, suffered a closed fracture of the right femur and compound fracture of the right tibia in a motorcycle accident in July, 1954. Initial treatment elsewhere consisted of intramedullary nailing of the femur and plaster fixation of the tibia. The femoral fracture united, but non-union was present in the tibia ten months later. Due to soft tissue induration left by the compound wound, a sliding graft reinforced by thin iliac strips was performed. The patient was returned to duty wearing an ischial weight-bearing brace six months later. Roentgenogram a year postsurgery revealed solid union.

The Phemister Type of Onlay Graft (without Breakdown of Fibrous Union and minus Added Internal Fixation)

This finds its greatest application in delayed union. It is a relatively simple procedure, best used where efficient immobilization is possible principally through plaster support (Case VIII). It is indicated in previously infected fractures because of the danger of recurrence of infection (Case IX). Cancellous inlay-onlay iliac grafts followed by skeletal traction and suspension is a relatively safe method of dealing with previously infected non-unions of the femur, especially in the supracondylar area. The early motion possible in traction may help to preserve function. Occasionally, internal fixation that is still functioning may be left *in situ*. The simple addition of a bone graft in these cases is enough to stimulate union (Case X). Well established non-union is best managed by other means.

CASE VIII. N. P., a thirty-two year old officer, received comminuted fractures of the right humerus and left clavicle, concussion and dislocation of the right knee when ejected from a bomber at 4,000 feet on October 29, 1954. His hospital course after reduction of the injuries was complicated by a series of pulmonary emboli. In spite of three months in a hanging cast and an additional three months in a plaster shoulder spica, early non-union was evident in the right humerus by April, 1955. Onlay iliac grafts were applied in May, 1955. When the plaster Velpeau dressing was removed three months later, union appeared advanced. Roentgenograms in June, 1956, nine months after return to duty, revealed solid bony union.

CASE IX. R. C., a twenty-five year old airman, suffered a compound, comminuted fracture of the left tibia in a motorcycle accident in July, 1953. An infected non-union resulted after open reduction and plating at another hospital. He was referred for treatment ten months postinjury. A cancellous bone graft performed after clearing the infection caused breakdown of skin and recurrence of drainage. The graft survived and drainage ceased after saucerization and application of a split-thickness skin graft. Union was finally secured after the application of a cross leg pedicle skin flap. When the patient was discharged in July, 1956, a drop of drainage still stained his dressing each day.

CASE X. In August, 1954, D. W., a twenty-two year old airman, incurred compound, comminuted fractures of the left femur, tibia and medial malleolus associated with severe neurovascular damage to the left foot. Initial treatment elsewhere consisted of open reduction of the tibial and femoral fractures followed by plaster spica support. When he was admitted to Parks Air Force Base Hospital, non-union of the femur and tibia were present. The latter was complicated by infection, a skin defect on the dorsum of the foot, poor circulation and anesthesia of the foot. Onlay iliac grafts to the femur, without disturbing the internal fixation, proved successful. After cessation of tibial drainage an iliac graft caused recurrence of massive infection and finally loss of the graft. Irreparable damage to the leg and foot necessitated below-knee amputation.

SUMMARY AND CONCLUSIONS

1. Fifty cases of delayed union or non-union in the long bones, treated by a variety of methods, have been subjected to critical analysis.

2. It is the authors' belief that no fixed concept of management is applicable to all cases. Success is best sought for through an elastic approach in which each case is weighed on its individual merits. A treatment of choice utilizing an osteogenic inductor and some form of efficient immobilization is then selected and tailored as necessary to the prevailing circumstances.

3. Recommendations have been made regarding the method of choice in certain situations encountered in this group.

4. Infection comprises the chief obstacle to success in the management of any case of delayed union or non-union.

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Fractures of the Os Calcis

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It has been accepted that the end results of fractures of the os calcis are poor. Conn [1] said that "fractures of the os calcis are serious and disabling injuries with poor end results." In cases reported by Conn there was pronation of the heel, valgus of the forefoot and persistent disabling pain. Conservative treatment is usual. That many methods are described to deal with this fracture is evidence of dissatisfaction with results. These methods are: (1) reshaping of the os calcis by pounding with a mallet; (2) Phelps-Gocht reduction apparatus; (3) Böhler compression clamp and pins; (4) open reduction; (5) primary subtalar arthrodesis, delayed subtalar arthrodesis, and primary or delayed triple arthrodesis; and (6) excision of the entire os calcis.

The Böhler two-pin method of treatment gives satisfactory results.

Reduction of fractures of the os calcis is possible. End results can be better than those suggested in the literature.

CLASSIFICATION

Fractures of the os calcis vary. A simple classification of types follows:

Group I (isolated fractures): (1) vertical fracture of the tuberosity, (2) beak fracture, (3) fracture of sustentaculum tali and (4) fracture of the anterior edge of the os calcis.

Group II: Involvement of the subtalar joint and varying degrees of displacement, crushing and widening.

MECHANISM OF INJURY

In Group I the mechanism of the injury is not clear.

In Group II the mechanism of injury is a fall from a height landing on the foot. The foot is fixed on the ground so that the force of the body weight is transmitted through the tibia and the astragalus to the os calcis. The inferior wedge-shaped portion of the astragalus is pushed into contact with the os calcis, in the angle between its anterior and posterior articular facets. This force causes the fracture.

The type of fracture is determined by the degree of valgus present at the time of impact. The fracture lines may pass near the posterior facet with or without displacement, or through the facets, or cause extensive comminution.

X-RAY INTERPRETATION

A lateral and an axial x-ray are taken of the os calcis. In the lateral view the plane of the subastragaloid joint is noted. The tuber angle is the angle between the plane of the subastragaloid joint and the plane of the superior surface of the tuberosity of the os calcis. This angle normally averages about 35 degrees. This angle in fractures is diminished because of the upward displacement of the fragments.

In the axial view there is a step between the anterior and posterior articular facets of the os calcis. With fracture there is widening of the os calcis laterally with a valgus tilt and displacement.

Reduction is aimed at pulling the os calcis downward and then backward to correct shortening; correction of widening by compression; and correction of valgus by placing the heel in varus.

MATERIAL

Forty-one patients with fracture of the os calcis were treated at Meadowbrook Hospital from 1952 to 1955. There were thirty-one males and ten females. The youngest patient was eight years old and the oldest was seventy-seven. The majority of the patients fell into the age category of thirty-five to fifty-five years.

There were twelve cases of isolated fractures

of the os calcis belonging to Group I (29.3 per cent). These patients were treated by immobilization alone.

There were twenty-nine cases of fractures involving the subtalar joint belonging to Group II (70.7 per cent). Five of these patients had no displacement and were treated by application of casts alone. One patient underwent peroneal tenotomy and was placed in a plaster cast. One patient had additional tarsal fractures and was treated by a primary triple arthrodesis. Twenty-two patients had displacement of the fracture with reduction in the tuber angle of varying degrees. These patients were treated by the two-pin method of Böhler.

TECHNIC

With the patient under general anesthesia a Steinmann pin is passed through the tuberosity of the os calcis and another pin is placed through the tibia. The foot is placed on a reduction frame with the knee flexed to about 90 degrees. Traction by the frame is applied in the long axis of the leg with a force of about 30 pounds, i.e., 1½ inches on the frame. The traction force is now changed backward to restore the tuberosity of the os calcis. The widening is corrected by lateral compression with a Böhler clamp. The heel is carried into varus by the clamp. The heel varus must be maintained. A long leg plaster cast is applied, incorporating the pins. The pins are removed in five weeks and a new long leg cast applied. This plaster is maintained for an additional eight weeks. A plaster boot is applied for four to eight more weeks. Walking in plaster, with full weight bearing, is permitted after fifteen weeks. The cast is removed after four to five months' total immobilization. The patient is fitted with high top shoes with a Thomas heel.

PRINCIPLE OF TREATMENT

The cause of persistent pain and disability may be due to traumatic arthritis, deformity or capsular fibrosis.

We believe the cause is the malalignment of the subtalar joint by valgus of the os calcis. Weight bearing results in undue strain on this joint with disability. When the fracture heals in a valgus position of the heel, the result is a traumatic flatfoot with peroneal spasm. This condition can be prevented by maintaining the os calcis in varus position.

"Keep the foot under the leg" is sound advice. When the valgus deformity is corrected and varus position of the heel maintained during healing, the subtalar joint will become stiff in functional alignment for body weight transmission.

RESULTS

End result studies were done on seventeen patients.

In assessing the patients, attention was paid to (1) the valgus deformity of the heel, (2) the period of total disability, (3) x-rays taken for changes of the subtalar joint, and (4) the amount of motion present in the subtalar joint.

The average follow-up was seventeen months. The minimum was seventeen months with a maximum of three years.

Four patients belong to Group I. They were treated with casts. The maximum disability period in these patients was less than six months. They had uniformly good results.

Thirteen patients belong to Group II. One patient without displacement was treated by immobilization alone. This patient had no complaints and went back to work in six months.

Twelve patients were treated by the two-pin method. They had a disability period ranging from nine months to one year. Nine of the twelve patients were conscious of their injured foot. They complained of varying degrees of pain on prolonged standing or walking. They were able to perform their activities of daily living.

No patient showed a valgus deformity of the heel. The peroneal tendons were not in spasm.

The motion in the subtalar joint was 0 degrees in twelve patients. Three patients had a few degrees of motion with pain.

The x-ray examination revealed that it was possible to reduce and maintain the reduction of the fracture in nine of the twelve patients. The reduction and maintenance was incomplete in three patients. These patients showed arthritic changes in the subtalar joint on x-ray.

COMPLICATIONS

One patient had a pin tract infection that cleared completely. In a seventy-seven year old patient gangrene of the foot developed. This elderly patient was treated on the fourth day following the injury.

Elderly patients should be treated cautiously

and after evaluation of the peripheral vascular system.

Associated compression fractures in the lumbar vertebrae occurred in 8 per cent of the patients in this series. The vertebral fracture must not be overlooked.

CONCLUSIONS

1. There is undue pessimism regarding the end results of fracture of the os calcis.

2. The fracture which does not involve the subtalar joint shows uniformly good results. The fracture which involves the subtalar joint with displacement may cause disability.

3. The cause of disability and pain results from malalignment of the subtalar joint. This malalignment is always in the position of valgus of the heel.

4. The two-pin method of Böhler has been modified in that the heel is maintained in varus. This varus is maintained until the fracture heals.

Treatment with the heel in varus has not been stressed. Loss of motion of the subtalar joint in a functional position is the goal.

5. Forty-one patients were treated, and seventeen had follow up studies.

6. The results obtained have been found satisfactory.

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Local Anesthesia for the Aged and Poor Risk Patient with Fracture of the Hip (137 Consecutive Operations)

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WITH the increasing age of the population, fractures of the hip are being seen with greater frequency. In South Dakota, where the longevity is the highest in this nation [7], an unusual opportunity has been afforded us in the treatment of fracture of the hip of various types. Our mortality rate for surgery performed on these fractures and for the first four weeks thereafter has been 12.5 per cent in those patients over eighty years of age [9], and 14.28 per cent in those ninety years or over [10].

Further improvement in the mortality rate lies in the fields of preoperative and postoperative care and factors, other than the actual hip nailing technic itself. Of the many factors which contribute to a proper mortality rate, anesthesia is a major one. Koons [3] has reported a series of cases of fractures of the hip in which spinal and inhalation anesthetics were principally used. In 45 per cent of those patients receiving spinal anesthesia, blood pressure fell below 90 mm. Hg, while only 22 per cent of those receiving inhalation anesthesia supplemented by intravenous therapy showed a drop below this level. With these episodes of hypotension there was an increase in the occurrence of cerebrovascular accidents, mental confusion and myocardial infarcts, confirming the physiologic fact [12] that the cerebral, coronary artery and glomerular blood flow is dependent largely upon the maintenance of the usual blood pressure. The incidence of pneumonia and respiratory complications was only slightly greater in the inhalation group. Many anesthesiologists are in agreement with Osborn [5] that the geriatic patient is an excellent candidate for local anesthesia, yet no substantial series has been reported from this country in which local anesthesia has been used on patients with fractured hips.

The advantages and disadvantages of local anesthesia in the aged and poor risk patient with a fractured hip can only be accurately determined by studying a series of cases in which the anesthesic was given by a standard technic [9] and administered by an individual experienced in its use. I have accordingly reviewed the records of all personal cases from 1951 through 1956 in which I administered the local anesthesia. One hundred thirty-five patients were operated upon under local anesthesia (two female patients having consecutive fractures bilaterally); forty-seven operations were performed at McKennan Hospital, and ninety at Sioux Valley Hospital. Of the total 137 procedures, 107 were on females and thirty were on male patients. The average age of the entire group was 79.5 years, the oldest being ninety-nine years and the youngest fifty-four years. Pathologic conditions were present in the majority of these patients. Evidences of senility were present to a variable degree in a majority of the patients. Seventy-one patients had hypertension or gave a history of having had hypertension, and the highest systolic blood pressure of this group was 250 mm. Hg. Five had had previous strokes, three had a history of having had previous coronary attacks, and three were being treated for congestive heart failure. Nine patients had diabetes. Two patients had pathologic fractures apparently on the basis of malignancy, site undetermined. Neurologic conditions included three cases of severe paralysis agitans, one case of epilepsy, one case of cerebral palsy since birth, and one case of total disability with severe arach-

noiditis. Two patients had pernicious anemia, one patient had severe rheumatoid arthritis, and one patient had nephritis with an albumin of plus 4. The patients reported in this series, therefore, represent the greatest surgical risk we will accept in our group for hip nailing. In none of the cases herein reported was the use of pentothal® sodium (thiopental sodium) combined with the use of local anesthesia, a procedure which we perform commonly in our better risk patients to reduce the amount of pentothal required.

Local anesthesia is particularly indicated in the aged patient when it is considered undesirable to depress the patient by putting him to sleep, or to subject the patient to the hazards of a spinal anesthetic and particularly the marked hypotension which frequently occurs. The administration of a spinal anesthetic to a patient with a fractured hip is a painful procedure, despite the fact that these geriatric patients have a decreased reflex irritability and pain sensitivity. It has been stated that the greatest error in modern anesthesia is the employment of deeper planes of anesthesia than are required [*8*]. With a general anesthetic there is a decreased cough reflex and frequently depressed respiration during the postanesthetic period [*2*]. When a patient is anesthetized, any regurgitation from the gastrointestinal tract can easily be aspirated into the lungs. Under local anesthetic these potential dangers are eliminated.

Premedication, and particularly morphine, should be used in small doses [*8*]. As a rule of thumb, we have used only $\frac{1}{8}$ gr. (.00809 gm.) of morphine in patients seventy to eighty years old, $\frac{1}{12}$ gr. (.00539 gm.) in patients in the eighty-year group, and only $\frac{1}{16}$ gr. (.00404 gm.) in those of ninety or over, combined with $\frac{1}{150}$ gr. (.00043 gm.) of scopolamine. We have observed no ill effects from scopolamine, although we have avoided its use in the confused patient; the amnesia it produces with morphine was not of a permanent character in any of these patients. Barbiturates in small doses, e.g., $\frac{3}{4}$ gr. (.0485 gm.) of seconal,® were used in 112 cases. While barbiturates are said to elevate the minimal lethal dose of local anesthetic [*4*], their principal use here is for sedation. Because of the slower excretion and detoxification, all medications must be kept at a minimum [*2*].

The technic used for injecting the anesthetic into the fracture-hematoma has been previously reported [*9*]. With the patient in the supine position, the needle is injected from a point 1 inch below and 1 inch lateral to the mid-point of the inguinal ligament; with trochanteric fractures these measurements are increased approximately 1 inch. Fifteen cubic centimeters of procaine hydrochloride solution (2 per cent) are injected into the fracture-hematoma, which is present for two or three days following injury. The fracture site, in fractures of the femoral neck, may be injected with successful results for as long as one week after injury, despite the fact that blood can no longer be aspirated. The injection is done in the patient's room. Transportation of the patient to surgery is then no longer painful and the patient is moved with ease. Care should be taken in placing the patient on and off the fracture table; a sacral abrasion incurred at this time may eventuate in a decubitus ulcer, particularly in those patients who had a hypoproteinemia [*11*] and who lack individual nursing attention. The fracture can be reduced without delay since no additional anesthesia is required. After fixation on the fracture table, local infiltration laterally (with $\frac{1}{2}$ or 1 per cent procaine hydrochloride solution) along a 6 inch line extending distally from the greater trochanter down to the periosteum completes the procedure. The site of towel clips is likewise injected. We have avoided the use of vasoconstrictors in the procaine because of their cardiac and cerebral effects [*4*], and in no instance were they used in this series. No toxic reactions or convulsions occurred in any of these patients in whom the procaine was used.

The duration of the operation and the stability of the blood pressure are factors which cannot be ignored. Lorhan [*4*] states that mortality is increased by approximately 25 per cent if the operation is over one hour's duration. Rankin and Johnston [*6*] have stated that good judgment, speed and gentleness compose the essential triad for surgical success in the aged patient. In this series the average operating time was 58.91 minutes, which included the exposing and the developing of all roentgenographic plates. The lowest recorded blood pressure of any patient in this series was 80 mm. Hg, which occurred in one patient. Only five patients had a fall in blood pressure below 90 mm. Hg, and the lowest average systolic blood pressure for the entire series was 136 mm. Hg. Of

these five patients, only one died (with uremia on the eighteenth postoperative day). Carp [1] has pointed out the value of supportive therapy in this age group. During forty-seven of the operations blood was given. Practically all the patients received intravenous fluids with dextrose; sodium chloride was avoided in those patients with poor cardiac or renal reserve. The aged patient is particularly prone to hypoxia [5]; in fifty-one cases oxygen was given and in nine cases it was combined with nitrous oxide for analgesia. No deaths occurred during surgery or in the operating room.

The mortality in this series of aged and poor risk patients, including all deaths occurring for four weeks postoperatively, numbered fourteen cases (10.22 per cent). An analysis of these cases re-emphasizes certain prognostic facts which were statistically demonstrated in our previous studies on this subject [9,10]. Of the fourteen patients who died, the average age was 84.8 years as contrasted to 79.5 years for the total series; the increased mortality with the increasing age is evident. Eight of the fourteen fatalities occurred in male patients despite the fact that there were only thirty male patients in the entire series. The prognosis in an elderly male patient with a fractured hip is definitely more guarded than in a female patient of a corresponding age. The average minimal blood pressure incurred during surgery was 127.9 mm. Hg in those patients who died, as contrasted to 136.0 for the entire series. The average length of operation in the fourteen patients who died was 61.14 minutes (which included the exposure and development of the roentgenograms) as contrasted to 58.91 minutes for the entire series.

Cardiovascular-renal disease accounted for the majority of fatalities. Cardiac disease was the cause of four deaths. Four patients died from pulmonary emboli; one of these patients showed marked nephrosclerosis at necropsy. In one patient a fatal cerebral thrombosis developed, and one died with uremia. One patient died from bronchopneumonia; inanition was the cause of death in one patient who refused to eat and died despite all intravenous therapy; a minimal bronchopneumonia occurred terminally. One eighty year old white man was operated upon only with considerable reluctance after urinalysis showed a plus 4 albumin and medical consultation was obtained. The patient survived the operation under local anesthesia, but died the same night from acute pulmonary edema which was undoubtedly due, in part, to the diminished plasma protein osmotic pressure. The edema might have been prevented by a more aggressive postoperative program of intravenous colloid and protein replacement therapy. The primary impression, that the patient was not a satisfactory candidate for surgery, was undoubtedly correct. An unusual complication occurred in a ninety-two year old white man who was under continuous medical management for a cardiac condition; a duodenal ulcer developed with severe and fatal hemorrhage as demonstrated at necropsy. There was no history of previous gastrointestinal disturbance or symptoms.

CONCLUSIONS

The use of local anesthesia for 137 hip nailings of fractures of the femoral neck and trochanter in extremely poor risk and aged patients has proved satisfactory. No patient died during the procedure or in the operating room. Fourteen patients died during the first four weeks following surgery, or 10.22 per cent of the operations. This study definitely shows that the incidence of hypotension with local anesthesia is markedly reduced (3.65 per cent) as compared to spinal (45 per cent) and inhalation anesthetic (22 per cent) [3]. In addition to the stability of the blood pressure, the absence of pain in transporting the patient to the operating room, the prompt reduction of the fracture without further anesthesia, the maintenance of the pharyngeal, laryngeal and cough reflexes, and the avoidance of postoperative respiratory and circulatory depression are the principal advantages of local anesthesia. The disadvantages of local anesthesia include the additional time required in the administration of the anesthetic in the patient's room, the possibility of toxic reactions and the potential danger of bone infection; the latter two did not occur in this series. Our experience warrants continued and further use of local anesthesia in the poor risk and aged patient with recent fracture of the hip.

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The Management of Anesthesia for Adrenalectomy

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DURING the past several years adrenalectomy has been advocated as a means of treating advanced disseminated carcinomatosis, particularly that stemming from malignant disease of the breast and prostate. This report is limited to our experience with fifteen patients with mammary carcinoma, upon whom twenty-nine individual operations were performed.

Metastases usually involved the lungs, skeletal system, skin, lymph nodes, liver, brain, ovaries and adrenal glands. The inter-related effects on metastatic growth and extension of ovarian, pituitary and adrenal cortical secretions have been well established and afford a logical basis for the operation. The results of oophorectomy and adrenalectomy on patients with mammary carcinoma have been evaluated and documented [*1,2,6,7*], but there is little information in the literature [*3–5*] relevant to their anesthetic management. It is abundantly clear that medical teamwork plays an important role in the management of these patients. Proper preparation for surgery by the endocrinologist, skillful handling by the anesthesiologist and surgeon during the operation, and vigilant postoperative care are all essential.

Patients undergoing oophorectomy and adrenalectomy for carcinomatosis are among the poorest risks coming to surgery. Because vital organs have usually been involved by metastatic growth, the patients' ability to react to stress has been greatly impaired and there is difficulty in breathing deeply after operation. Consequently, the procedure was generally carried out in two stages in our series. Bilateral oophorectomy and unilateral adrenalectomy usually were performed in the first stage, and the second adrenal gland was removed seven to ten days later. Oophorectomy and left adrenalectomy were performed in the first operation on thirteen of our patients, right adrenalectomy and oophorectomy were carried out on one patient, and bilateral adrenalectomy alone on one patient. The patients ranged in age from thirty-seven to seventy-three years. Oophorectomy was carried out with the patients in the supine position and adrenalectomy in the lateral position. Since lying on the side further impeded efficient ventilation, endotracheal anesthesia, with either assisted or controlled respiration, was employed in most instances. There is always the possibility of entering the pleural space during adrenalectomy, and use of a cuffed endotracheal tube makes possible immediate control of respiration and application of positive pressure until the rent in the pleura can be surgically repaired.

We have learned that psychologic preparation for a patient who is to undergo adrenalectomy is of paramount importance. Most of our patients had undergone radical surgery previously, and many had been subjected to radiotherapy and additional biopsies. Any patient facing surgery can make good use of her doctor's understanding, but to a woman with carcinomatosis, on the verge of adrenalectomy, sympathy and empathy can be of vital importance.

Sudden and catastrophic changes can occur during adrenalectomy. The problems arising during surgery are hypertension, hypotension, tachychardia and collapse. Anesthetics which induce hypotension or make it difficult to maintain an even blood pressure must be avoided. Deep anesthesia is likewise undesirable, because prolonged sleeping time and delay in reacting from anesthesia, resulting from cere-

bral and respiratory depression, expose the patient to further hypotension and anoxia. Because spinal anesthesia does not permit constant, dependable control of blood pressure, in our series twenty-six operations were performed under endotracheal anesthesia and only three under spinal anesthesia. The improved oxygenation permitted by endotracheal anesthesia is particularly valuable when there are pulmonary or pleural metastases.

In every surgical procedure requiring anesthesia, the adrenal cortex is normally activated through hypothalamic-pituitary-adrenocortical stimulation, in an attempt to increase steroid hormonal secretion [8]. Each of our patients, before the first operation, was treated as if both adrenals were going to be removed. We feel that such patients are seriously and chronically ill and have undergone a great deal of stress because of the metastatic involvement of vital organs, previous surgery, radiotherapy and other procedures. One must assume that their response to the strain of adrenalectomy may be less than adequate. The intramuscular injection of cortisone preoperatively is preferable to oral administration because of the creation of an intramuscular depot of cortisone, allowing for a more steady, even and dependable absorption of steroid. It must be remembered that twenty-four to forty-eight hours has to be allowed for the intramuscular administration of cortisone to produce its full physiologic effect. Therefore, the following preoperative cortisone schedule was carried out. Two days before operation 50 mg. were given intramuscularly every twelve hours. One day preoperatively 50 mg. were given intramuscularly four times a day. On the day of operation, two hours prior to surgery, 150 mg. were given intramuscularly.

Premedication of the patient was slanted toward prevention of as much cerebral and respiratory depression as was compatible with the degree of anesthesia which was mandatory. Meperidine and belladonna alkaloids were employed as necessary. Anesthesia was induced with small doses (100 to 200 mg.) of either thiopental or thiamylal sodium and was maintained with a mixture of 50 per cent oxygen and 50 per cent nitrous oxide, a technic which made it possible for the surgeon to employ electrocautery. An aqueous infusion of 0.1 per cent of succinylcholine in 5 per cent dextrose in water facilitated endotracheal intubation, and permitted the most controllable muscular relaxation during surgery. It also had the most readily reversible action. Intravenous doses of 10 to 15 mg. of meperidine were used when indicated, but were needed infrequently. A transfusion of 500 cc. of whole blood was started when adrenalectomy was begun.

Thirteen of our patients, in twenty-one operations, displayed a rise in blood pressure of from 10 to 50 mm. Hg and an increase in pulse rate of from 5 to 30 beats per minute, with manipulation of the adrenals, in response to an increased discharge of adrenalin. If the blood pressure fell below normal after removal of the adrenal, an infusion of hydrocortisone was initiated. This was needed in six patients. All patients were observed closely postoperatively. Pulse and blood pressure were taken and recorded every ten to fifteen minutes for the first twenty-four hours, and rectal temperature was taken every four hours. Operations were performed early in the morning so that the patients were not made to fast too long, and fluid and electrolyte balances were maintained. These patients tolerate morphine poorly, so meperidine was the narcotic of choice [9]. If, despite all efforts, adrenal cortical insufficiency occurred, with the picture of rapid circulatory collapse, increased pulse rate, fall in blood pressure, elevated temperature and rapid unconsciousness, treatment was instituted as swiftly as possible. An intravenous infusion of 5 per cent dextrose in 0.45 per cent saline, to which 100 mg. of hydrocortisone (one 20 cc. ampule) had been added, was begun at once. Also, 100 mg. of powdered hydrocortisone succinate dissolved in 2 cc. of water was given rapidly intravenously. The effects of these preparations were usually manifest within five or ten minutes. We have had no occasion to employ nor-epinephrine, but it should always be on hand to maintain blood pressure until the corticoids can take effect, in case a patient goes into profound shock. The 150 mg. of cortisone given intramuscularly preoperatively will help maintain the patient subsequently while the immediate situation is being taken care of by the intravenously administered hydrocortisone.

Postoperatively, the steroid depot must be maintained. The patients in this series received 50 mg. of cortisone intramuscularly every four to six hours for the first twenty-four hours postoperatively. The patient who is properly

supported for the first twenty-four hours after adrenalectomy will usually get along well. Too much salt or desoxycorticosterone acetate should be avoided because of the possibility of producing edema.

The major physical complaints for the first two or three days—inability to lie on the side without discomfort, pain on breathing and difficulty in coughing—are good reasons for having performed the operation in two stages. Most of our patients tolerated the second operation better than the first, probably because an adequate depot of cortisone had been established.

CONCLUSIONS

Successful management of the patient undergoing adrenalectomy demands teamwork on the part of the anesthesiologist, the endocrinologist and the surgeon. Meticulous attention to the patient before, during and after the operation is mandatory. General endotracheal anesthesia offers most protection for the patient and the best means of control for the anesthesiologist. Hypotension, anoxia and adrenalcortical insufficiency must be recognized and efficiently treated immediately. Transfusions of whole blood, use of steroids and control of electrolyte and fluid balance are of immeasurable value to the patient.

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The Prevention of Postoperative Pulmonary Complications

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THE general trend toward increased longevity has resulted in the performance of a greater number of major surgical procedures on patients in the older age group. This trend has been investigated and condoned by many authors and it is generally agreed that elderly patients should not be denied needed surgery [2,4,6,7,9,11]. Because of a rather unique economic situation, the charity patients entering Strong Memorial and Rochester Municipal Hospitals fall into the category of older patients, creating an ideal situation for further study of major surgery in old patients. In addition to having a large concentration of patients in this age group, conditions of operative technic and pre- and postoperative care remain fairly uniform for a given period, and thus it was recognized that an ideal situation was present for a study of this type. Realizing, then, that the care of many old patients under relatively standard conditions created not only an unusual opportunity but also an added responsibility, a twofold program was instituted: every attempt was to be made to prevent complications from occurring and there was to be a continuous audit to evaluate the methods adapted for the prevention of complications. This report deals with the program only insofar as it related to pulmonary complications.

Past experience indicated that most of the pulmonary complications were atelectasis, pneumonia, or a combination of the two. It was also recognized that many old patients, especially males, had chronic productive coughs with excessive tracheobronchial secretions that were ineffectively expectorated. This situation was most often due singly or in combination to pulmonary emphysema, chronic bronchitis or diffuse mild bronchiectasis. With this information as a basis, the following prophylactic measures were undertaken. A careful history and physical examination resulted in remarkably accurate information about the pulmonary disorder and reserve of a given patient. This knowledge was further implemented by the small chest film that was routinely taken on admission and by observing the patient as he walked briskly down the corridor or was made to climb a flight of stairs. Fluoroscopy, diagnostic bronchoscopy, bronchograms, laminagrams and pulmonary function studies were done only for specific indications.

Sputum cultures were obtained at the time of admission. An unusual flora, such as Escherichia coli in cases of pyloric obstruction, was an indication for specific antibiotic therapy. Antibiotics, however, were not employed routinely either prior to or after operation. It was felt that such a course would be contrary to the accepted tenet that antibiotics should not be used indiscriminately and that the patients would be exposed to such complications as the development of sensitivity and to staphylococcal enteritis [1,5,10]. Using the same reasoning, topical antibiotics by inhalation were not used without specific indication.

It was further reasoned that if the measures used postoperatively for the prevention of pulmonary complications were of real value, they should be of much more value if they could be initiated during the preoperative period. Accordingly, part of the program was directed at liquefying tenaceous secretions. To this end, bronchial detergents were inhaled by the patient three or four times a day. The low humidity, especially during the winter months, was combated by the continuous use of steam tents. Postural drainage three times a day and a regimen of turning, coughing and hyperventilation every two hours temporarily controlled

the "chronic basilar disease" of most patients. Smoking was forbidden. In a few patients who would not or could not raise their secretions, nasotracheal suction at regular intervals was necessary and bronchoscopy was rarely indicated. Within several days, on this regimen, crepitant rales cleared and patients became free of cough. Ambulation was thought to be important and patients were made to walk prescribed distances and to spend much time out of bed.

During the actual surgical procedure the anesthetists were especially alert, maintaining tracheobronchial toilet by suctioning whenever necessary and in open chest procedures by frequent inflation of the lungs. Additional safeguards employed have been outlined by Greene [3], who at the time was head of the division of anesthesiology.

Postoperatively, vigilance was continued. Patients were made to turn every two hours in an effort to prevent dependent edema and to aid in blood return from the lower extremities. They were encouraged to cough at stated intervals. In a comfortable sitting position with a nurse or doctor firmly supporting the wound, coughing was remarkably effective and productive. Those patients who were unable to raise secretions were benefited by nasotracheal suction. This was accomplished by explaining the need for and outlining the procedure to the patient. Then the gauze-covered tongue was gently retracted by the operator and with the suction on, but with the tubing clamped, a catheter (No. 18 plastic Levin tubes are excellent) was introduced through the nose while the patient "panted like a dog" through his mouth. Once the trachea was entered, suction was instituted with gentle movement of the catheter to stimulate coughing while the patient supported his own wound. Suctioning was of short duration so as not to significantly lower the partial alveolar oxygen pressure for long periods. During the entire procedure the patient was reassured. Following a short rest period, effected by clamping but not removing the catheter, another period of suctioning was initiated. After the trachea was free of secretions, the patient's head was turned far to the right and the catheter advanced, with the result that it frequently entered the left main bronchus. Suction was repeated as often as necessary in this new position and then a similar procedure was carried out on the opposite side. This maneuver was repeated frequently enough, often every two hours, to keep the tracheobronchial tree free of secretions. Bronchoscopy was necessary rather infrequently for removal of retained secretions. When indicated, it was usually done on the ward without anesthesia since even topical anesthesia obtunds the cough reflex, not only during the procedure but also during the period following bronchoscopy. Tracheotomy was rarely necessary.

Hyperventilation was part of the program and was successful only because cooperative nurses actually insisted on patients rebreathing into a paper bag. Carbon dioxide and carbon dioxide and oxygen mixtures were not used. Neither were any of the various machines that deliver alternating positive and negative pressure used routinely. At the time of this study the rebreathing apparatus described by Schwartz and Dale [8] was not ready for clinical use.

The aforementioned outlined program was made available with modifications to all patients. Obviously there was variation in the amount of preparation and postoperative care needed. This depended on the status of the patient and the type of surgery that was performed. In emergencies the preoperative preparation was curtailed and sometimes was necessarily completely omitted.

Complications were audited by entering each patient's name in a ledger at the time of operation along with the type of procedure that was performed. Any time a complication developed, it was entered under one of the following headings: pulmonary, cardiovascular, wound, genitourinary or "other." At the time of discharge or death, the chart was again reviewed and appropriate notations made. Even the most minor complications were recorded. A wound showing mild redness was counted as a complication and minor degrees of atelectasis were not dismissed. Any patient having a single febrile episode to 38°c. or above was considered as having a complication. Fever was not considered to be a normal sequela of an operative procedure but a manifestation of a complication. This concept was supported when it became evident that of the entire series only two instances of fever of undetermined origin were found. Also included as complications were incorrect preoperative diagnoses, technical errors, headache following spinal anesthesia and the like.

During the study 823 procedures were performed in the operating room by the resident staff on the General Surgical Service. This

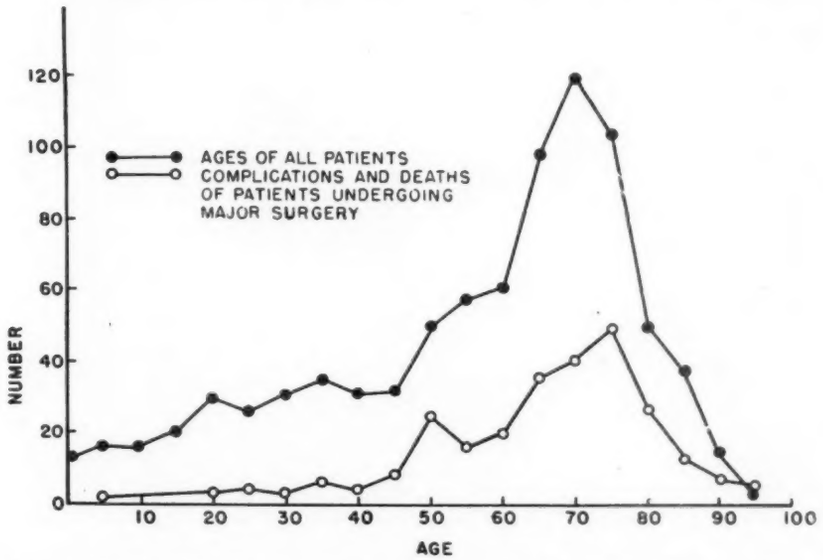

FIG. 1. This graphically depicts the relationship of age of all patients operated upon, with the complications that developed in those undergoing major surgery.

figure includes the most minor as well as the major procedures. The list of the various operations and the number of times they were performed is recorded in Table 1. The total here exceeds the 823 procedures that were performed. Thus, if a patient underwent cholecystectomy and subtotal gastrectomy at the same time, it is counted as a single procedure, but on the list of operations it is listed in both places. On the other hand, colostomy is considered to be part of an abdominoperineal proctosigmoidectomy and is only recorded as such.

Figure 1 graphically depicts the relationship of the age of all patients operated upon with the complications developed by those patients undergoing major surgery. It is readily apparent that the peak age incidence of patients was early in the seventh decade. The second curve represents numbers of complications and deaths and not patients. It is obvious that some patients had more than one complication and that in most instances one or more complication preceded the death of a patient. The incidence of complications roughly parallels the age of the patients except that the peak occurred later in the seventh decade.

The number of patients in whom various types of complications developed is shown in Figure 2. It is readily seen that respiratory difficulties vied with wound complications. Atelectasis, in spite of efforts to prevent it, led the list of respiratory complications and was responsible for almost all of the pneumonias that occurred.

Data are not presented that allow for a statistical analysis, proving a regimen such as the one outlined decreases complications. However, it was the definite belief that such was the case. There are those who will contend that the pulmonary complications are inordinately high as compared with their own experience, even with this program. With this in mind it is important to emphasize that the patient material was such that pulmonary complications could be expected to be high. It is also necessary to point out that many cases

TABLE 1
OPERATIONS PERFORMED

Operation	Times Performed
Head and neck	15
Chest wall	38
Pulmonary and cardiac	19
Upper gastrointestinal	68
Lower gastrointestinal	45
Appendectomy	56
Biliary	60
Sympathectomy	24
Amputation	54
Hernia repair	63
Biopsies and excisions	120
Sigmoidoscopies	92
Exploratory laparotomy	37
Others	143

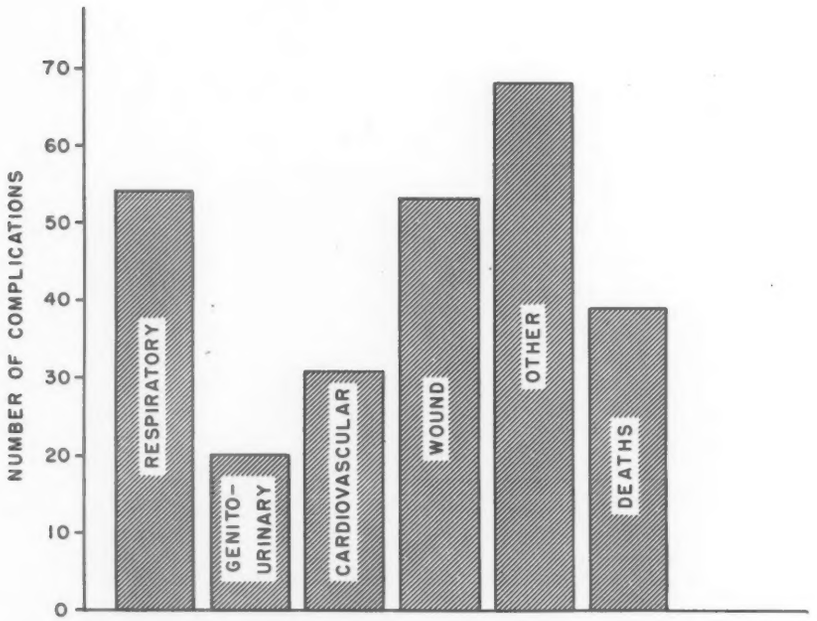

FIG. 2. The incidence of the various types of complications that occurred are compared.

of atelectasis were of a minor nature, being manifested only by decreased breath sounds over the involved lung field and involving so little of a lobe that it did not appear on chest films. Even though minor, such degrees of atelectasis are definite, and after instituting the various measures outlined there is definite evidence of clearing of the atelectasis as shown by the replacement of the decreased breath sounds by fine crepitant rales, indicating that once more air is entering and leaving the formerly occluded segment of lung. Fever, if it had developed, promptly fell to normal. On continued treatment the rales disappeared and breath sounds became normal. Unless vigilance is constant, many episodes of atelectasis may go unrecognized and then either clear spontaneously or more commonly develop into pneumonitis. One caution is exemplified by a patient who underwent pulmonary resection. His emphysema and chronic bronchitis made him an ideal candidate for development of atelectasis, and consequently during the postoperative period efforts at prophylaxis were intense, so much so that moderate edema of a major bronchus developed with atelectasis on this basis. Except in a few instances, pneumonia was always preceded by atelectasis and generally, if atelectasis was controlled, pneumonia did not develop.

It is recognized that much has been written about atelectasis both from the clinical and from the laboratory standpoint, and nothing in this program is original. Rather, it is a combination of methods that worked well in the prevention of atelectasis. These measures are simple to carry out and effective and, therefore, are recommended.

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The Suprarenal Veins

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WHILE exhaustive dissections have been made of the arterial supply of the adrenal [1], there are no descriptions of dissections designed specifically to display the venous pattern. Cunningham's "Textbook of Anatomy" [2] gives the following description of the veins of the suprarenal glands. "Each gland is drained by a single large vein which emerges through the hilum, the right one to join the inferior vena cava, the left to joint the left renal vein behind the body of the pancreas."

From their cadaver material, Anson and his associates amplify this description. They state that the veins are disposed in the simplest possible arrangement, i.e., one vein for each suprarenal gland. "The suprarenal vein of the right side is exceedingly short, it courses transversely to end quickly in the inferior vena cava. The vein of the left gland is longer; it descends to the left renal, almost always receiving the inferior phrenic vein and often capsular tributaries. It reaches the renal opposite the termination of the internal spermatic vein."

With the increasing interest in the ablation of the suprarenals, it was felt worth while to carry out dissections of the injected veins. At the same time, opportunity was taken to see if these veins had communications with the portal system. This paper records findings in ten subjects.

METHOD

In fresh autopsy material the heart and lungs were removed, a ligature being placed on the inferior vena cava either at its entrance into the right atrium or at the level of the hepatic veins. The peritoneum of the right paracolic gutter was incised and reflected medially until the inferior vena cava was identified just below the renal veins. A ligature was tied at this point, and a wide bore cannula introduced on the cardiac side and secured with a second ligature. Latex was injected until adequate filling of all the tributaries of the segment of the inferior vena cava was obtained. Dissection was carried out by displacing the liver into the right thoracic cavity and the intestines into the left, the diaphragm being divided. This caused some distortion of the angle of entrance of the tributaries. Measurements were then taken of the diameter and length of the vessels and sketches prepared.

OBSERVATIONS

Subject 1 (Fig. 1) was a seventy-six year old man. Blood pressure prior to death was 110/70 mm. Hg. The cause of death was bronchopneumonia.

Right side: A single main tributary, 1 cm. long and 0.6 cm. in diameter, entered the vena cava 3.7 cm. proximal to the right renal vein. In addition, five small thread-like veins draining the capsule passed to the peritoneal reflection at the bare area of the liver, the suprarenal vein and to the right renal vein; a small vein issued from the lateral border of the gland and passed along that border to join a right inferior phrenic vein.

Left side: The vein immediately joined the confluence of two left inferior phrenic veins to form a tributary 0.7 cm. in diameter and 1.4 cm. long, which entered the left renal vein 3.0 cm. from the inferior vena cava, opposite the left testicular vein. In addition, small capsular venules joined the phrenic vein and veins from the perirenal fat.

An accessory suprarenal was present to the left and behind the inferior vena cava. Its vein joined a left lumbar vein and entered the vena cava posteriorly at the level of the right suprarenal vein.

Subject 2 (Fig. 2) was a sixty-six year old woman. There was no record of blood pressure

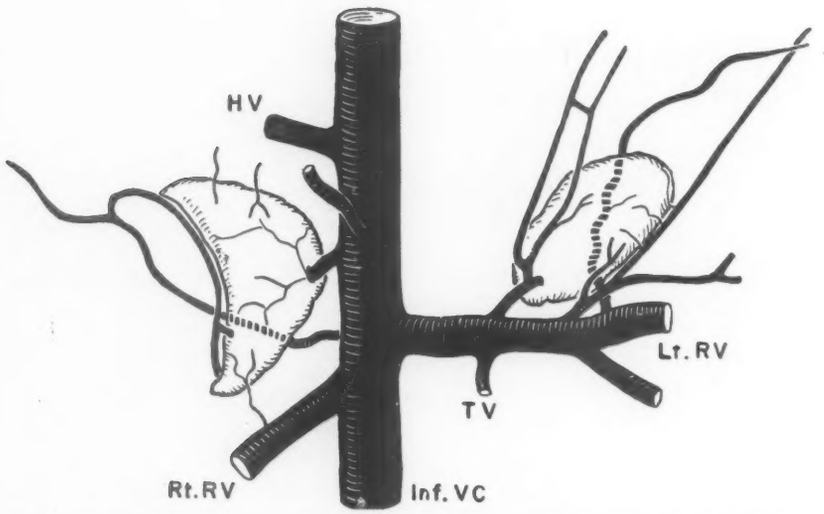

FIG. 1. Subject 1. HV = Hepatic vein. Rt. RV = Right renal vein. Lt. RV = Left renal vein. Inf. VC = Inferior vena cava. TV = Testicular vein. OV = Ovarian vein.

before death. Aspiration of vomitus was the cause of death.

Right side: A single main tributary, 0.5 cm. in diameter and 1.0 cm. long, entered the inferior vena cava 3.5 cm. proximal to the right renal vein. Small capsular venules drained to the main vein, to the retrocaval tissues and from its lateral border to a perirenal fat venule.

Left side: A long vein issued from almost the superolateral end of the suprarenal gland, ran across it and joined the left inferior phrenic vein to form a tributary 2.6 cm. long and 0.4 cm. in diameter, which joined the left renal vein 2.5 cm. from the inferior vena cava and 2.5 cm. medial to the left ovarian vein. Small capsular venules joined the inferior phrenic veins, the main suprarenal vein, posteriorly an ascending lumbar vein and laterally a perirenal fat vein.

Subject 3 (Fig. 3) was a seventy-two year old man. Blood pressure before death was 130/70 mm. Hg. Carcinoma of the prostate with multiple metastases, including the liver, was the cause of death.

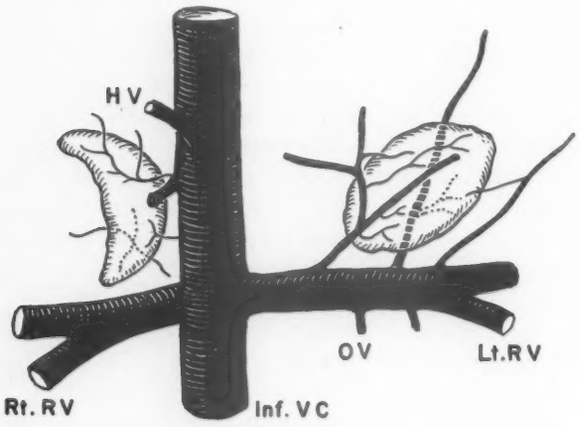

FIG. 2. Subject 2.

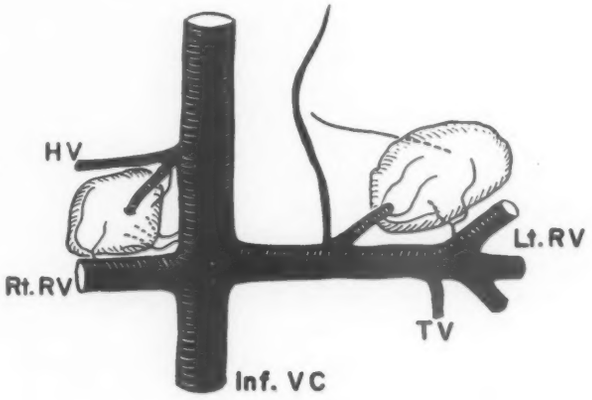

FIG. 3. Subject 3.

Right side: The main vein, 0.3 cm. in diameter and 2.0 cm. long, joined a small hepatic vein from the right lobe of the liver close to its junction with the inferior vena cava, 3.2 cm. proximal to the right renal vein. Due to the hepatic metastases the gland was closely applied to the inferior surface of the liver. Capsular venules passed to the right renal vein, retrocaval tissue and to the junction of the main vein with the inferior vena cava.

Left side: A main vein, 0.4 cm. in diameter

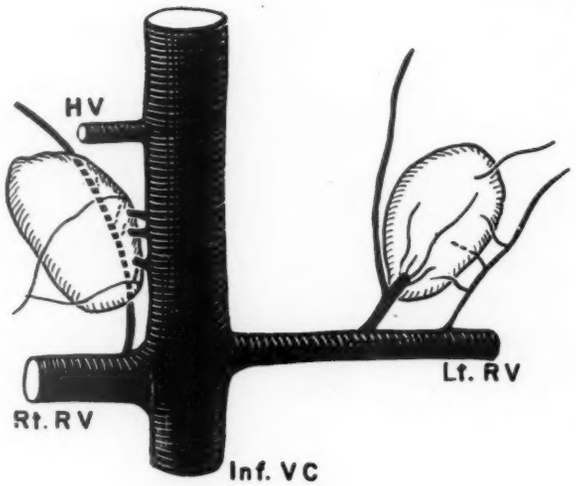

FIG. 4. Subject 4.

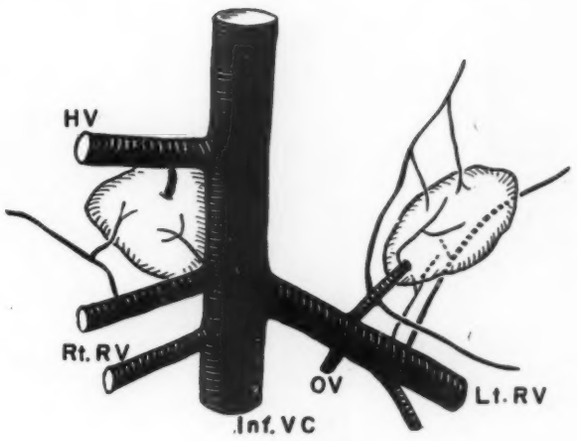

FIG. 5. Subject 5.

and 0.5 cm. long, joined the left inferior phrenic vein to form a trunk 0.4 cm. in diameter and 0.9 cm. long, which entered the left renal vein 4.5 cm. from the inferior vena cava. From the capsule, venules ran laterally to a subordinate renal vein, superiorly to a renal capsular vein and medially to the main suprarenal vein.

Subject 4 (Fig. 4) was a seventy-nine year old man. Blood pressure before death was 140/90 mm. Hg. Bronchopneumonia was the cause of death.

Right side: Three main veins, measuring 0.25, 0.15 and 0.1 cm. in diameter in order from the most caudal proximally, joined the inferior vena cava, the middle vein being 2.3 cm. from the main right hepatic vein and 3.5 cm. above the right renal vein. In addition, the right inferior phrenic vein received a leash of vessels from the posteromedial part of the capsule of the suprarenal, and two anterior capsular venules formed a ring connecting the uppermost main vein with the lowermost.

Left side: The main vein, 0.3 cm. in diameter and 0.5 cm. long, joined the left inferior phrenic vein to form a trunk, 0.4 cm. in diameter and 0.9 cm. long, which entered the left renal vein 4.5 cm. from the inferior vena cava. From the capsule, venules ran laterally to a subordinate renal vein, superiorly to a renal capsular vein and medially to the main suprarenal vein.

Subject 5 (Fig. 5) was a forty-nine year old woman. Blood pressure before death was 90/60 mm. Hg. Carcinoma of the breast with metastases was the cause of death.

Right side: The main vein, 0.3 cm. in diameter, passed superiorly to join almost immediately the main right hepatic vein posteriorly, 1.3 cm. from the inferior vena cava and 3.5 cm. above the upper of the two renal veins. The suprarenal itself lay almost posterior to the inferior vena cava. Small capsular branches passed to a perirenal vein and to the inferior vena cava.

Left side: A main vein, 0.4 cm. in diameter and 2.8 cm. long, was joined close to its confluence with the left renal vein 3.6 cm. from the inferior vena cava, by the left inferior phrenic vein measuring 0.3 cm. Also joining at this point was a small renal capsular vein. From the capsule, venules ran to the left inferior phrenic vein, to the main suprarenal vein, directly to the left renal vein and to a left renal capsular vein posteriorly. The diameter of the veins was approximate due to flattening of the vessels. The suprarenal vein was opposite the ovarian vein.

Subject 6 (Fig. 6) was a fifty-eight year old man. Blood pressure before death was 150/90 mm. Hg. Coronary occlusion was the cause of death.

Owing to the anomaly of the inferior vena cava, injection of the smaller vessels was incomplete, although they could be seen unfilled.

Right side: An accessory vena cava, arising from the right renal vein, 0.5 cm. in diameter, received the major right hepatic vein and then passed through the vena caval opening in the diaphragm to enter the right atrium; 3.2 cm. from the renal vein and 2.0 cm. below the right hepatic vein it received the main suprarenal vein, 0.4 cm. in diameter.

Left side: The main continuation of the in-

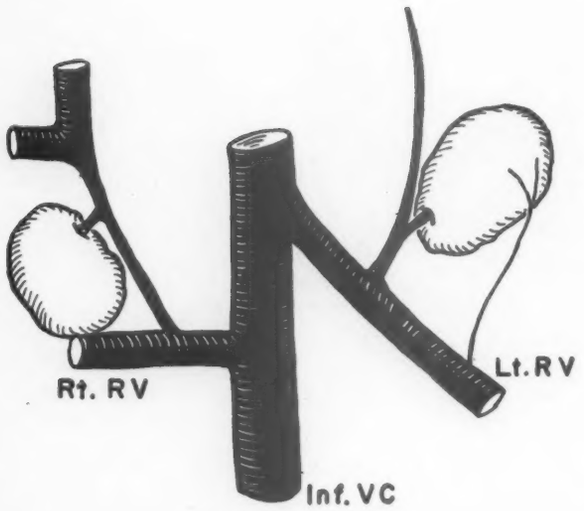

FIG. 6. Subject 6.

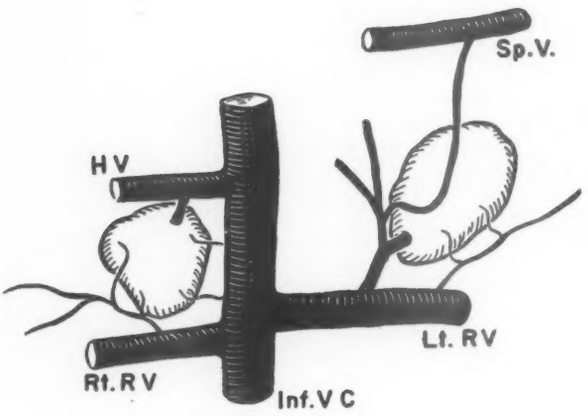

FIG. 7. Subject 7.

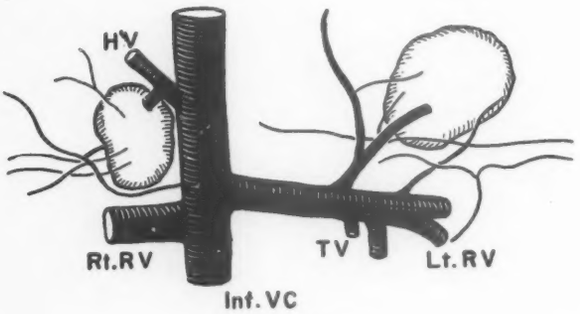

FIG. 8. Subject 8.

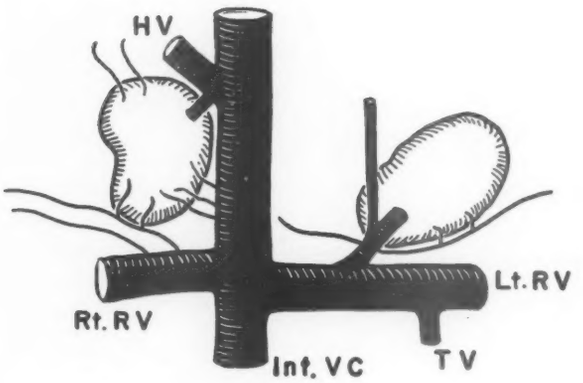

FIG. 9. Subject 9.

ferior vena cava, 2.4 cm. in diameter, passed through the aortic opening to join the azygos system. Just prior to its exit from the abdomen it received the left renal vein. The left main suprarenal vein, 0.4 cm. long and 0.3 cm. in diameter, joined the left inferior phrenic vein to form a vein 0.5 cm. in diameter and 1.3 cm. long, which then joined the renal vein 2.0 cm. from the vena cava. The only capsular venules injected passed from the lateral border to join the left renal vein.

Subject 7 (Fig. 7) was a seventy-five year old woman. Blood pressure was not recorded before death. Aortic aneurysm was the cause of death.

Right side: A short vein, 0.8 cm. in length and 0.3 cm. in diameter, passed from the upper end of the suprarenal directly into the lowest right hepatic vein close to its junction with the inferior vena cava. The hepatic vein was 4.0 cm. proximal to the right renal vein. Small capsular veins passed to the right inferior phrenic vein and to the vena cava.

Left side: The main suprarenal vein, 0.3 cm. in diameter, received the left inferior phrenic vein and formed a vein 0.5 cm. in diameter which joined the left renal vein 3.1 cm. from the inferior vena cava. Also joining the left inferior phrenic vein, 0.6 cm. from its junction with the suprarenal vein, was a vein, 0.2 cm. in diameter, running from the splenic vein, receiving no branches and passing anterior to the suprarenal gland. Small capsular venules passed from the anterolateral border of the suprarenal to a renal capsular vein which joined the left renal vein.

Subject 8 (Fig. 8) was an eighty-four year old man. Blood pressure was 120/65 mm. Hg before death. Bronchopneumonia was the cause of death.

Right side: The main suprarenal vein, 0.2 cm. in diameter, joined the main right hepatic vein 0.4 cm. from the junction of the latter with the inferior vena cava, which was situated 4.0 cm. above the right renal vein. A small vein, 0.1 cm.

in diameter, passed from the lateral aspect of the gland to a perirenal vein. Small capsular veins passed superiorly to the diaphragm in the region of the bare area of the liver and laterally to perirenal fat venules.

Left side: A long main suprarenal vein passed anteriorly to a small high aberrant renal artery and vein to join the left renal vein 3.3 cm. from the vena cava and medial to the left testicular vein. It received the left inferior phrenic vein, giving it a diameter of 1.4 cm.

Small capsular veins passed to this vein, to the main suprarenal vein, to the accessory renal vein and also to the main renal vein and to a perirenal capsular vein.

Subject 9 (Fig. 9) was a sixty-five year old man. Blood pressure before death was 150/80 mm. Hg. Left ventricular failure was the cause of death.

Owing to a leak at the level of the hepatic veins, the injection material filled the veins poorly.

Right side: The main suprarenal vein, 0.4 cm. in diameter, joined the inferior vena cava just below the entrance of the right hepatic vein, 4.5 cm. above the left renal vein. Capsular veins passed to the liver capsule, to retrocaval tissue and to venules from the perirenal fat.

Left side: The main suprarenal vein, 0.5 cm. in diameter, joined the left renal vein 2.5 cm. from the inferior vena cava, and received the left inferior phrenic vein. Capsular venules drained to the suprarenal vein and to a vein passing from the perirenal fat to the retrocaval region. The left testicular vein joined the renal vein lateral to the suprarenal vein entrance.

Subject 10 (Fig. 10) was a sixty-eight year old woman. Blood pressure before death was 210/130 mm. Hg. Cerebral thrombosis was the cause of death.

Right side: Two suprarenal veins were present. The upper, 0.3 cm. in diameter and 2.0 cm. long, passed to the inferior vena cava 6.0 cm. above the right renal vein. The lower, 0.4 cm. in diameter and 2.5 cm. long, passed to the inferior vena cava 1.5 cm. above the right renal vein. Capsular veins passed from the superior border to the hepatic capsule and from the inferior border to a perirenal capsular vein.

Left side: The main vein, 0.4 cm. in diameter and 2.5 cm. long, joined the left renal vein 2.9 cm. from the inferior vena cava and medial to the left testicular vein. It did not receive a left inferior phrenic vein but only a venule from the retrocaval tissue. Capsular veins passed to a perirenal fat vein.

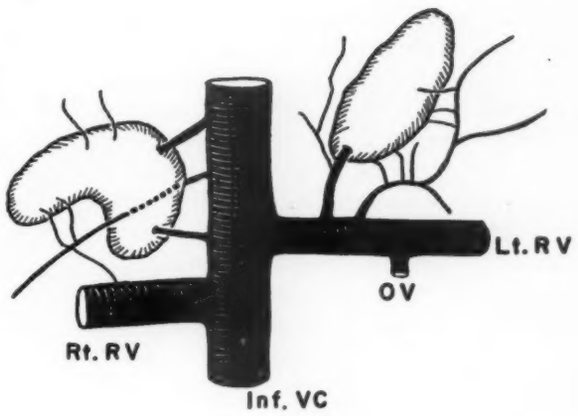

FIG. 10. Subject 10.

SUMMARY

The right suprarenal vein was single in eight subjects. In these, its average diameter was under 0.4 cm. and it joined the inferior vena cava (or anomaly) in five instances, on the average 3.6 cm. proximal to the right renal vein. In three instances the single vein joined a right hepatic vein close to the junction of the latter with the inferior vena cava. In these subjects the right hepatic vein was within 4.0 cm. of the right renal vein. In one subject there were two right veins, and in another, three, all of which joined the inferior vena cava between the lowest right hepatic vein and the right renal vein. In the subject with an anomalous inferior vena cava, the right vein joined the anomalous vein, passing to the right atrium and receiving blood from the right lobe of the liver. Venules from the capsule of the right suprarenal joined the main suprarenal vein, perirenal fat veins, the right renal vein, the right inferior phrenic vein, veins in relation to the peritoneal reflection and capsule of the bare area of the liver and to the inferior vena cava. The left suprarenal vein was single in all subjects and after receiving the left inferior phrenic vein had an average diameter of over 0.4 cm. It invariably joined the left renal vein, an average distance of 3.1 cm. from the junction of the latter with the inferior vena cava, and opposite or medial to the gonadal vein. The junction with the left inferior phrenic vein took place either close to the renal vein or within

an average of 1.6 cm. distal to the renal vein. In one subject the left inferior phrenic vein did not join the suprarenal vein. The capsular veins on the left side joined the main suprarenal vein, the inferior phrenic vein, the perirenal fat vein and the renal vein or accessory renal vein, and ascending lumbar vein. The only subject displaying a raised blood pressure prior to death did not have any increase in diameter of the suprarenal vein. In one subject the inferior phrenic vein received a tributary from the splenic vein, a naturally occurring splenorenal anastomosis previously described [3].

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Acute Pancreatitis Associated with Acute Cholecystitis

THE CURATIVE VALUE OF BILIARY TRACT SURGERY

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ACUTE pancreatitis is occasionally associated with acute cholecystitis. This has been recognized more often since the serum amylase determination has been available and has been used routinely for patients on whom the clinical diagnosis of acute cholecystitis is made. This form of pancreatitis is usually the edematous variety which is mild.

The purpose of this study was to determine the frequency with which chronic relapsing pancreatitis occurs following the surgical correction of the biliary tract abnormalities of patients in whom acute pancreatitis and acute cholecystitis have occurred concomitantly. The development of chronic relapsing pancreatitis under such circumstances was found to be rare.

MATERIAL

The records of 452 patients on whom the diagnosis of acute pancreatitis was made between the years 1935 and 1955 were reviewed. Of these, sixty cases constitute the basis for this study inasmuch as they met the specified criteria, which were: (1) The diagnosis of acute pancreatitis associated with acute cholecystitis was made. (2) The diagnosis of acute pancreatitis was substantiated by an elevation of the serum amylase level or by gross evidence of acute pancreatitis at surgery. (3) The diagnosis of acute cholecystitis was substantiated by typical clinical or surgical findings in addition to the demonstration of biliary tract lithiasis at the time of surgery. (4) All patients underwent surgery to eradicate biliary tract disease at the time of the acute attack or at a later date. (5) There was a minimum follow-up period of one year subsequent to surgery. The average follow-up period for the sixty patients included in the study was approximately four years.

It is obviously difficult to be certain of the concomitant presence of both acute cholecystitis and acute pancreatitis. Likewise, the differentiation of an attack of biliary colic from acute cholecystitis is not always easy. All the patients included in this evaluation were hospitalized with the diagnosis of acute cholecystitis based on typical findings, for this appeared to be the predominant problem clinically. The presence, in addition, of acute pancreatitis was indicated by typical gross findings at the time of surgery or by an elevation in the serum amylase determination. The serum amylase level has been determined routinely in recent years for all patients with acute cholecystitis. The concomitant presence of acute cholecystitis and acute pancreatitis was recognized in the majority of patients during the last ten years of this study. Biliary tract lithiasis was found at the time of surgery in all patients.

Of the group, thirty-six patients were females and twenty-four were males. Two-thirds were in the fourth to sixth decades of life.

RESULTS

In one patient of the group of sixty chronic relapsing pancreatitis developed after definitive surgery on the biliary tract consisting of cholecystectomy, exploration of the common bile duct with removal of "gravel" and dilatation of the sphincter of Oddi. (Table 1.) At the

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time of this surgery calcified areas were present throughout the pancreas, and it is likely that the patient had been having repeated "relapses" of acute pancreatitis over the preceding three years. This patient subsequently underwent surgery again consisting of sphincterectomy, vagotomy and gastroenterostomy. He continued to have attacks of pain for the following year, after which symptoms subsided.

TABLE 1
RESULTS OF SURGERY FOR ACUTE PANCREATITIS ASSOCIATED WITH ACUTE CHOLECYSTITIS

Operation	No. of Patients	No. Developing Chronic Pancreatitis
Cholecystostomy only	3	0
Cholecystostomy, later cholecystectomy	3	0
Cholecystectomy	17	0
Cholecystectomy, exploration of common duct	34	1*
Cholecystectomy, exploration of common duct, sphincterotomy	3	0
Totals	60	1

*Attacks subsided later after sphincterectomy, vagotomy and gastroenterostomy.

In fifty-nine patients of this series the biliary tract surgery relieved symptoms when it was sufficiently complete to eradicate the biliary tract disease. In six patients cholecystostomy was first performed, but two of these patients had further episodes of acute pancreatitis. Cholecystectomy with removal of additional stones performed later resulted in freedom from further difficulty. Cholecystostomy had been performed elsewhere in two additional cases several years prior to the attack of acute pancreatitis. Both these patients have been free of further symptoms for two years since cholecystectomy and, in one of the patients, exploration of the common bile duct and sphincterotomy.

In seventeen patients cholecystectomy alone was sufficient to relieve symptoms. In the remaining thirty-six patients of this series of sixty, the common bile duct was explored in addition to cholecystectomy. Stones were found in the common duct in fifteen of this group. Sphincterotomy was performed in only three of these patients. Following exploration of the common bile duct, which nearly always included dilatation of the sphincter of Oddi, a T-tube was left in place for a few weeks, although in a number of instances it remained in place for three to five months. The length of time that the T-tube was left in place did not appear to influence the outcome.

The duration of follow-up in the group of sixty patients was from a minimum of one year to nineteen years, the average being approximately four years. There was no hospital mortality in this series of patients.

Twenty-three of the sixty patients had experienced multiple attacks of acute severe upper abdominal pain prior to biliary tract surgery. It is not possible to be certain as to how many of these attacks were due to acute pancreatitis, but a number were proved attacks of acute pancreatitis.

COMMENTS

It is evident that the prognosis for acute pancreatitis associated with acute cholecystitis is good. The acute pancreatitis is usually mild. The development of chronic relapsing pancreatitis is rare if the biliary tract abnormalities are eradicated. These conclusions are in agreement with those reached by other observers [*1*,*2*]. These features must be considered in evaluating any surgical procedures for pancreatitis.

The pathogenesis of acute pancreatitis when associated with acute cholecystitis is uncertain. It is known that anything interfering with the flow of the juice in the pancreatic ducts will result in an elevation in the serum amylase and can cause the edematous form of acute pancreatitis. It is conceivable that the inflammatory process in the gallbladder and surrounding tissues in some way leads to interference with the flow of juice in the pancreatic ducts in some patients on some occasions. It is of interest that patients seen on repeated occasions with acute cholecystitis will have an elevated serum amylase associated with only a few of the more severe attacks.

Recurrent attacks of acute pancreatitis may occur until the biliary tract disease is eradicated. Cholecystostomy alone may not do this, for all stones may not be removed or stones may re-form resulting in recurrence of acute pancreatitis. Many of the patients in whom acute pancreatitis develops associated with

acute cholecystitis will also require exploration of the common bile duct. In this series exploration of the common duct was carried out in nearly two-thirds of the patients, and stones were found to be present in the common duct in nearly one-half of the patients on whom this procedure was performed. We believe that an important part of the common duct exploration is the dilatation of the sphincter of Oddi [3]. Isolated episodes of acute pancreatitis can occur, however, even many years after surgical removal of biliary tract abnormalities, but this is rare. Acute pancreatitis may also occur occasionally after cholangiograms made by the introduction of radiopaque material via a T-tube, especially if the injection is made with excessive pressure.

The duration of T-tube drainage following cholecystectomy and exploration of the common bile duct did not appear to be significant in this group of patients. The T-tube was removed at intervals of several weeks to five months following surgery. It is our practice not to remove the T-tube until the patient can tolerate continuous clamping of the tube for at least one to two weeks.

Our plan of management for patients with concomitant acute cholecystitis and acute pancreatitis has been to employ conservative therapy during the acute stage [4]. This consists of bedrest, continuous nasogastric suction, intravenous fluid and electrolyte therapy, antibiotics, warm compresses to the abdomen, medication for relief of pain and close observation of the patient. If evidence of impending perforation of the gallbladder occurs, as indicated by an elevation in temperature of 102°F. or more, leukocytosis in the vicinity of 20,000 per cu. ml. or more, and a tender, tense gall bladder on examination of the abdomen, cholecystostomy is performed. Otherwise the acute attack is permitted to subside and elective surgery is performed approximately six weeks later. At surgery, exploration of the common bile duct must be seriously considered and a high percentage of these patients require this procedure.

SUMMARY AND CONCLUSIONS

1. Acute pancreatitis associated with acute cholecystitis is usually mild in severity and will subside with conservative therapy.

2. Acute pancreatitis rarely recurs after surgical correction of all biliary tract abnormalities in this group of patients.

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Vaginal Plastic Surgery Based on a New Concept of the Anatomy of the Female Genital Tract

III. BIRTH INJURIES TO THE POSTERIOR VAGINAL WALL*

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UNLIKE the cystocele, which has been shown to be a misnomer [1], the term rectocele is, in some cases, a perfectly legitimate one. It should not be confused, however, with the complete eversion of the posterior vaginal wall, which will be considered as a distinct entity.

RECTOCELE

A rectocele is the result of the longitudinal splitting of the perirectal fascia due to the expansile force of the presenting part in its progress through the vagina. There may be no visible laceration of the vagina. The elasticity of the vaginal wall can tolerate considerable stretching; but the fascia, a non-elastic tissue, may give way, and, in the course of time, a herniation of part of the anterior rectal wall will take place, a true rectocele.

The diagnosis of a rectocele is readily made. There is, of course, the circumscribed bulge in the rectovaginal septum. However, this may not show in some cases when the patient is in the lithotomy position on the examining table. Rectal palpation reveals a quite characteristic defect. There is definite thinning of the rectovaginal septum in the center, while on the periphery there is a thickened border, the retracted musculature.

Surgical Treatment. Usually the operative procedure is quite simple. The vaginal mucosa is lifted up and the individual layers of the rectal and vaginal walls are identified and restored in their natural relation in the median line by proper suture. However, in the occasional case in which the rectovaginal septum is thinned out to almost tissue paper consistency, extreme care must be exercised because of the possible hazard of penetrating the rectum. Therefore, in order to avoid such an accident, the following maneuver must be utilized:

With the left index finger in the rectum, the thickened border of the rectovaginal defect is carefully palpated all around the periphery for proper orientation. Then, with this finger as a guide and with the scalpel in the other hand, an incision is made in the vaginal mucosa a few millimeters from the thickened border, and followed all around to outline the extent of the defect. The finger is withdrawn from the rectum, gloves changed, and the operation continued.

The incision in the vaginal mucosa is deepened down to the musculature, and with the utmost care the vaginal mucosa is peeled off the rectal mucosa, going in medially toward the center on one side, and then on the other side, until the vaginal mucosa is completely freed, and removed. The rectal mucosa is now in the center, and the border of the periphery is freely exposed to view.

Starting from the border outward, the vaginal wall is stripped up laterally and all around, exposing the rectal musculature and, going as far out as necessary, careful search is made for the perirectal fascia. Having succeeded in this, the rest of the operative procedure is a very simple matter. The rectal musculature is brought together in the median line with a few interrupted sutures and the perirectal fascia

* Parts I and II appeared in the May and July 1957 issues, respectively, of *The American Journal of Surgery.*

with a continuous overlapping suture. The vaginal wound is closed in the usual manner.

Should the rectal mucosa be inadvertently injured, there is no need for alarm. If the opening is small, it is closed with a purse-string suture, submucously if possible. If the opening is more extensive, a continuous inverting suture is used and again submucously, if possible; however, in either case one or two inverting sutures are added. The wound will heal well. The gloves are changed, the soiled instruments discarded and the operation proceeds, as described previously.

COMPLETE EVERSION OF POSTERIOR VAGINAL WALL (WITHOUT RECTOCELE)

This condition is still referred to in textbooks as rectocele. However, if we adhere to the strict definition of rectocele as indicating a rectal hernia, application of this term to the everted vagina is a misnomer. Rectal palpation shows no defect in the rectovaginal septum, *per se*, and no thickened border so characteristic of a true rectocele. Actually, the descent of the vaginal wall pulls the rectal wall down with it, but not through it. The importance of that will be realized when the surgical treatment of this condition is discussed.

The posterior vaginal wall, loose over most of its extent, is firmly fixed to adjacent structures at certain points of its boundaries. This holds it in its natural place. The upper part, as has been discussed previously [*1*], is firmly attached to the lower part of the uterus, just above the cervix, and to the overlying pelvic fascia. A more extensive attachment exists along its lateral boundaries, that is, along the lateral fornices. Here, the connective tissue coat of the vagina is fused with the pelvic fascia of this area, and that holds it in position along its entire course.

The lower part of the posterior vaginal wall is attached, in the commissure of the inferior fornix, to the subjacent structures [*1*]. This does not play an important part in the evolution of the eversion of the vaginal wall above it, as will be shown later.

Pathogenesis. During labor, as the propulsive force of the uterine contractions drives the presenting part through the dilated cervix, the pounding against the upper vaginal wall may tear the vault of the vagina away from its uterine attachment. The result is a loosening and then a downward dislocation of the vaginal wall, as has been pointed out in a previous paper [*2*].

As the presenting part advances through the vagina, an additional force enters into play, an expansile force, that of the presenting part itself, which exerts considerable pressure in every direction on this relatively narrow passage. The lateral fornices provide for a certain amount of expansion; also, the elasticity of the vaginal wall tolerates a considerable amount of stretching. However, given a large head with hard bones, the results may be disastrous. If deep lateral lacerations occur, which go through the entire vaginal wall, involving the connective tissue coat and severing its contact with the pelvic fascia, there is nothing left to hold the vaginal wall in place. Intrarectal pressure and gravity now enter the picture, and a complete eversion is the result.

Such lacerations may occur submucously and are not recognizable either during or after delivery. However, the damage is there and will become manifest sooner or later.

Surgical Treatment. One approaches this phase of the subject with a great deal of hesitancy and with not a little misgiving. We are dealing with a complex disorder and distorted tissues and their landmarks. In addition, some parts are not readily accessible. This has challenged the ingenuity and skill of the most expert craftsmen in this field of surgery.

The conventional method of treating these "rectoceles" by the excision of so much "redundant" tissue and tightening up the rest of the vagina, then winding up with a "high perineorrhaphy," has of course proved unsatisfactory because such procedures do not restore normal, anatomic conditions. The original birth injuries, as described under the section on pathogenesis, are still there.

It would seem that the first step in the approach to treatment of this condition should be that we rid ourselves of the superstition that there is "redundant tissue." There is not, and there could not be, any such thing. Conditions are not conducive toward production of new tissue which might be considered as redundant. There is displacement of tissues and also stretching and thinning of the tissues. This explains the incorrect concept that the bulging and eversion of the vaginal wall is due to an excess of tissue which must be gotten rid of before anything else is attempted.

It is of interest to note that, in spite of ap-

pearances, the condition of the tissues involved is not irreversible.

Preparation of the Patient for Surgery. A survey of the general condition of the patient is, of course, routine in every surgical clinic. There is, however, a local treatment which is of the greatest importance so far as the ultimate result of surgery is concerned.

Reference has been made to the influence of the intrarectal pressure and gravity in the full development of the everted vagina. The indication, therefore, is to eliminate these two elements temporarily, preliminary to surgery. Such patients should be put to bed and kept there for a number of days and then, when examined in bed, a startling local change will be observed. The bulging will have receded, or may have completely retracted. A remarkable change will have also taken place in the condition of the vaginal wall: it will be definitely thickened and its surface will have become even somewhat corrugated.

What has happened? The vaginal wall is naturally a contractile structure, and when the unfavorable elements responsible for so much of its stretching and attenuation have been eliminated, a prompt anatomic and physiologic response has resulted. The patient may now be submitted to surgery.

Operative Technic. When the patient is on the operating table, under anesthesia, we proceed to search for the birth injuries responsible for the eversion of the vaginal wall. This is best accomplished by bidigital rectovaginal palpation. With the left index finger in the rectum and the right index finger in the vagina, careful palpation is made over every portion of the vaginal wall on one side, so that every thinned-out portion is localized. Such part consists of vaginal mucosa only while the musculature, connective tissue coat and pelvic fascia have retracted. Every such point is marked with the scalpel now in the right hand. The same is repeated on the other side.

The surgeon changes gloves and proceeds with the operation.

The vaginal mucosa is incised to the extent deemed necessary, peeled back medially and laterally, and search is made for the other constituents of the vaginal wall, the musculatures, the connective tissue coat and the ruptured pelvic fascia. The same is repeated on the other side. From here on the experienced surgeon will use his best judgment and skill to bring proper tissue together, which will help restore normal anatomic condition. Of course, proper orientation as to location of adjacent organs in this area is absolutely essential. It may be stated, in passing, that this is not a job for a tyro in surgery.

The repairing of the anterior wall and of the vault of the vagina is now in order. These procedures were described in previous papers and need not be repeated [*1*,*2*].

The repair of the perineum will receive special consideration in a future paper.

THE SAGGING VAGINA POSTPARTUM

Years ago I was quite familiar with this condition. When examining a primipara on the tenth or twelfth day postpartum for discharge from the hospital, I observed the following with a sense of disappointment: (1) The orifice of the vagina was rather roomy, readily admitting two fingers without the slightest resistance on the part of the patient. (2) The perineum was thin, flabby and lifeless.

I was somewhat puzzled. If memory served me right, I recalled very distinctly that immediately after the delivery was completed, I had examined the perineum very carefully; all I had found was a "slight median tear," which might be called a first degree laceration. I felt there was not very much to worry about and, as a conscientious obstetrician, promptly repaired the laceration with a few stitches.*

When this young woman came to me for her first examination, the orifice was a mere slit, and she resisted even the insertion of one finger. I was somewhat disturbed, but consoled myself with the thought that it was just a "relaxation of the tissues" and that things would right themselves in no time.

However, when the patient returned some weeks later for the final discharge examination, her condition did not really seem to be much better.

What does actually happen in such cases? Perhaps the answer may be found by rechecking the normal anatomy.

The vaginal orifice, books tell us and illustrations show, is guarded by a muscle, the sphincter vaginae. In addition, experience shows (books do not mention this) that there is a

* The modern obstetrician is spared that feeling, since he discharges his patients from the hospital on the fifth day and, of course, without an examination.

dense, tough fascia over that muscle. When a median, perineal tear occurs, both these structures are ruptured and their fibers retract to each side, and sphincter action is naturally completely abolished. The "few stitches" that were inserted took care of the superficial wound, while the deeper structures were not touched at all.

It must be quite apparent that even in so slight a laceration, as noted previously, every element of the tissues injured must be isolated, identified and properly repaired, if normal anatomic conditions are to be restored. How much more important that is in more extensive injuries need hardly be emphasized.

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Chronic Extradural Hematoma

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SINCE the classic paper on middle meningeal hemorrhage appeared in the *Guy's Hospital Reports* in 1885 [1], the syndrome of extradural hematoma has appeared in neurologic texts. The sequence of injury to the head fracturing the squamosa of the temporal bone with loss of consciousness, a lucid interval followed by progressively deepening coma, ipsilateral dilated pupil and contralateral hemiplegia has long been considered one of the true neurosurgical emergencies. However, as is so often the case, many exceptions have been reported to the classic sequence and in the physical findings that occur with an expanding extradural clot.

The inadequacy of the lucid interval as a diagnostic sign has been re-emphasized by Knighton [2] and Ver Brugghen [3]. Munro and Maltby [4] found no history of lucid interval in more than 50 per cent of their forty-four cases. Extradural hemorrhage may coexist with laceration or severe contusion of the brain, which would prohibit a return to consciousness before the clot became sufficiently large to cause unconsciousness itself. The amount and rapidity of bleeding would be factors that would influence the presence and duration of the lucid interval. Alcoholic stupor coexisting with injury to the head may also obscure the lucid interval. Knighton also pointed out that acute subdural bleeding, cerebral contusion with secondary edema and intracerebral hemorrhage could have a period of lucidity, and it has been felt generally that of the components of the classic syndrome, this was the least reliable.

A fracture of the skull usually is found with extradural hemorrhage and Munro states that "We have yet to see an extradural hematoma in the absence of a fracture of the bone in the immediate vicinity of the bleeding point, provided an adequate search for the latter has been made." However, epidural hematoma without fracture has been reported by other authors [5,6].

The development of a unilaterally dilated and fixed pupil has been noted in other types of cerebral lesions that might cause herniation of the uncus, such as acute subdural clot, acute traumatic edema of the temporal lobe and also direct trauma to the orbit with fracture of the superior orbital fissure. However, it is generally accepted that the unilaterally dilated pupil is one of the most reliable signs in the diagnosis of extradural hematoma.

Progressive contralateral hemiplegia may also be deceptive since paralysis may be found homolateral to the side of injury due to displacement of the opposite peduncle against the free edge of the tentorium.

The spinal fluid in the classic syndrome of extradural hematoma is clear. However, the spinal fluid will reflect the presence of bleeding into the subarachnoid space; and if a laceration of the brain occurs together with extradural bleeding, the fluid will be blood-tinged.

To disrupt further the stereotyped clinical description were the anatomic and clinical observations of Wood Jones [7] in 1912. In a paper entitled "On the grooves upon the ossa parietalia commonly said to be caused by the arteria meningea media," Wood Jones emphasized that ancient anatomists had considered the meningeal grooves in the cranial bones to enclose the meningeal veins. "The practice of injecting the arteries for the purpose of dissection led to the arteria meningea media being regarded as practically the sole vascular channel coursing over the dura mater and lodged within the grooves of the cranial bones." He took exception to the concept that these vascular impressions were solely due to pulsation of the meningeal arteries. He found that the diameter of the bony grooves was larger than that of the foramen spinosum and the

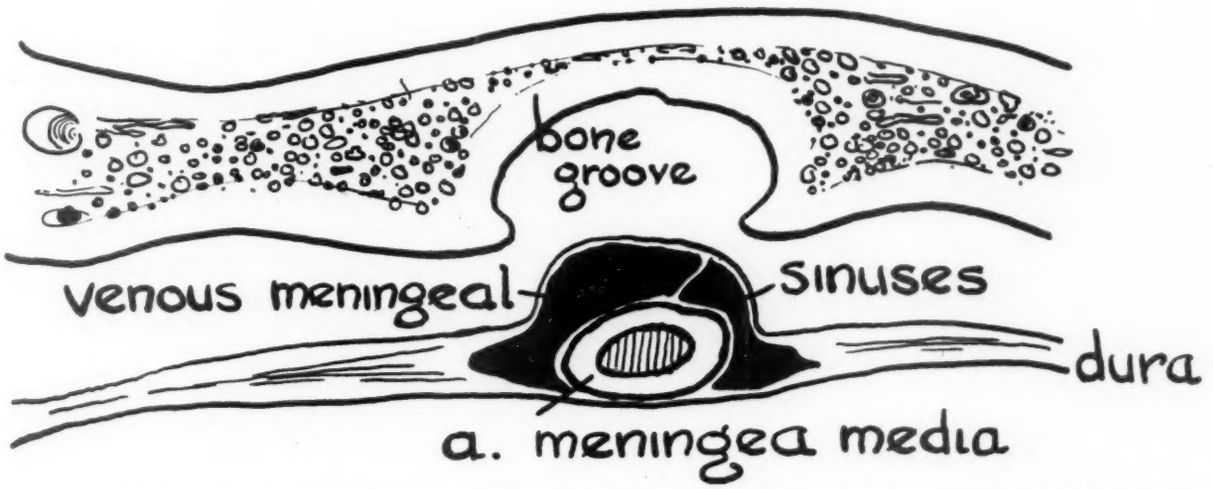

FIG. 1. Diagram of cross section through dura and temporal bone at the side of the meningeal artery and venous complex.

grooves became larger, rather than smaller, as they passed away from the foramen. He made sections of the dura (Fig. 1) and showed that the artery was but a small constituent of a much wider vascular channel, the bulk of which was composed of meningeal venous sinuses. He then demonstrated histologic sections from several cases of fatal extradural hemorrhage in which the middle meningeal artery was intact but the meningeal venous sinuses had ruptured. These cross sections through temporal bone demonstrate that the grooves contain venous sinuses and that the artery does not lie in contact with bone. Ver Brugghen [3] re-emphasized this point in his discussion of extradural hemorrhage in 1937 and suggested that at the time of surgery the origin of the bleeding could be determined by compressing the carotid trunk in the neck. If the bleeding diminished with pressure on the common or external carotid artery in the neck, it could be assumed that the source of bleeding was arterial. If, however, the bleeding accelerated with pressure on the neck, it could be deduced that the jugular vein was also being compressed with resultant back-bleeding from a venous tear.

It has been shown that the force of the arterial jet is not necessary to open the potential extradural space since Bell [8] was able to demonstrate a separation of the dura mater at the site of a blow to the skull. This fact would allow blood under a relatively low pressure to extravasate into the epidural space and would explain the occasional chronic development of an extradural hematoma.

Hemorrhage in the extradural space may arise from various sources: (1) Arterial bleeding from the middle meningeal branch of the internal maxillary artery. (2) Venous bleeding from the meningeal venous sinuses that surround and accompany the middle meningeal artery. (3) Venous bleeding from large dural sinuses, particularly when a fracture line occurs near the vertex or inion. (4) Venous bleeding from emissary veins perforating the outer table, diploë and inner table and entering the dura. This becomes more plausible when it is remembered that the dura develops embryologically from the inner periosteum of the calvarium. (5) Low pressure ooze from the diploic marrow. This would be of little significance in the temporal bone where the diploic space is virtually non-existent, but would be of greater significance over the vault; it has been shown [9] that intradiploic hematoma and cysts may form from marrow bleeding due to trauma.

Isolated cases of chronic extradural hemorrhage have been reported by Avol [10], Gurdjian [11], Jackson and Speakman [12], and Grant [13]. In Grant's case a period of six years elapsed between injury and operation. The hematoma was found over the right frontal pole. King and Chambers [6] reported eight cases in which delayed onset of symptoms were seen due to extradural hematoma. Six of their patients showed fracture lines on x-ray, and the longest period between injury and surgery was eleven days. The following additional case was treated by the authors on the neurosurgical service of the Cook County Hospital.

CASE REPORT

A forty-seven year old typesetter was struck on the head by an assailant on January 15, 1956. He was immediately rendered unconscious but soon regained consciousness and was removed to the House of Correction by the police because of absence of identification. He was sent to the Cook County Hospital Admitting Room five days later. During this five-day period little record of his course had been made except for the fact that he was able to feed himself. A fracture of the skull had been noted on x-ray. Physical examination on admission revealed an aphasic, dehydrated white male. The blood pressure was 140/60, pulse 80 and respirations 20. Bilateral mastoid ecchymoses were present. The pupils were equal and the fundi normal. There was a right hemiparesis including the face, but the plantar reflexes were normal. Lateral x-rays of the skull revealed extensive linear fractures of the left parietal and temporal bones. Anteroposterior films were not satisfactory. The patient was thought to have suffered a cerebral laceration and was treated conservatively.

He continued to have difficulty with speech and weakness on the right side persisted. When the anteroposterior x-rays of the skull were repeated, an 8 mm. deviation of the pineal calcification from left to right was seen. Because of the pineal shift, surgery seemed indicated. Twenty-one days had elapsed since injury. The preoperative diagnosis was subdural hematoma. A small, left scalp flap was turned over the central portion of the fracture and the bone was found to be markedly thinned. Craniectomy was performed and an organized extradural hematoma measuring 100 cc. was evacuated. There was no epidural bleeding after evacuation of the clot. The dura was sutured to the pericranium and opened. The subdural space contained no clot. The cortex showed minimal areas of contusion. The neurologic status rapidly returned to normal and the patient was discharged from the hospital two weeks later with the only neurologic residuum, continuing awkwardness of the right hand in fine movement. Postoperative x-rays of the skull revealed the pineal gland to be again in the midline.

COMMENTS

In a series of closed head injuries reported from the Boston City Hospital by Munro and Maltby [4], only 3 per cent of 1,200 patients admitted during a seven-year period showed significant extradural hematoma. However, LeCount and Apfelbach [14] reported that 20.6 per cent of 504 autopsied patients with fractures of the skull had significant extradural bleeding postmortem. Therefore, although the incidence of extradural bleeding in closed head injury is relatively small, the incidence of an extradural clot among those who succumb to closed head injury is seven times as great, indicating that the mortality from this lesion is still high and that the criteria for diagnosis requires re-evaluation to assure more widespread recognition of a potentially reversible condition.

CONCLUSION

It is evident from this and other reported clinical experience that the classic picture of the extradural hemorrhage may not appear in its complete form and that any or all of the component features may be altered. It is suggested that the rapidity and progression of symptoms and the clinical signs will depend on the amount, site and rapidity of bleeding in the extradural space. In this type of injury to the head, x-ray is of considerable value to demonstrate fracture lines adjacent to venous sinuses or across the meningeal grooves, and in chronic extradural bleeding it may indicate deviation of the pineal gland. Epidural hematoma, even in its chronic form, can only be treated by surgical intervention.

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Meckel's Diverticulum As a Source of Hemorrhage

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THE purpose of this article is to present Meckel's diverticulum as a source of intestinal hemorrhage. After a short review of this problem two such cases will be presented, one in a three year old boy and another in a seventy-three year old woman.

In this article I am omitting oft-repeated data pertaining to the genesis of Meckel's diverticulum, its relation to the mesentery, the percentage of its incidence in population, its forms, length and distance from the ileocecal junction, and also all possible complications except hemorrhage.

Normally the mucosa of Meckel's diverticulum is ileal. However, in 25 to 35 per cent there are islands of gastric mucosa [*1*], but sometimes duodenal, jejunal and colic mucosa and even heterotopic pancreatic tissue are also found (Barbosa, Dockerty and Waugh [*5*], Kaufmann [*13*], Zenker [*20*]), as well as ciliated epithelium (Aschoff [*2*]). Sometimes the entire mucosa is of gastric character. There is usually a well defined line of demarcation between the gastric and the ileal mucosa, and occasionally the ulceration that precipitates hemorrhage will appear at this junction, much akin to the stomal ulcer at the site of gastrojejunostomy [*14*]. However, the most frequent cause of hemorrhage from Meckel's diverticulum is peptic ulceration of the gastric mucosa; hemorrhage may occur without heterotopic mucosa [*10,11*].

The hemorrhages from Meckel's diverticulum are most frequently described in children, because in them they comprise a large percentage of hemorrhages from the gastrointestinal tract. In the large group of cases of Hodgson and Kennedy [*12*] pertaining to hemorrhages from the gastrointestinal tracts of 246 children, seventeen were from Meckel's diverticulum. Benson and Linkner [*6*] analyzed surgical complications of Meckel's diverticulum in sixty infants and children. In their material, intestinal hemorrhage was the most common indication demanding surgical intervention. A total of twenty-four or 40 per cent of all their patients had this complication, and fourteen patients of this group were one year of age or younger. In the material of Baffes and Potts [*4*] on 228 infants and children with blood in the stools, twenty-seven had symptoms from Meckel's diverticulum and twenty-three were admitted with severe rectal hemorrhage. In the majority of these cases ectopic gastric mucosa was present in the Meckel diverticulum and hemorrhage was secondary to peptic ulceration in the base of Meckel's diverticulum or in the wall of adjacent small bowel.

These hemorrhages are not always as severe as in the aforementioned material. Their principal characteristic is their periodicity, as emphasized by several authors. They vary in degree from slight to copious hemorrhage with discharge of large amounts of liquid and clots [*18*]. According to Brenneman [*8*], these clots provide the differential criteria from the hemorrhage due to intussusception and ileocolitis. Furthermore, they do not contain mucus. The color may be from bright red to tarry; often it is maroon.

Pain may or may not be present. If pain is present, it is usually lower abdominal pain and not intermittent as in the presence of intussusception [*14*]. If melena, particularly in children, is associated with lower abdominal pain and tenderness, Meckel's diverticulum should always be considered [*16*] as a source.

The diagnosis is chiefly a diagnosis by exclusion. Primarily ulcerative colitis should be

excluded. It is the most common cause of gastrointestinal hemorrhage in the material of Hodgson. Furthermore, polyposis of the colon and rectum, gastric and duodenal ulcer, varices of the esophagus and intussusception must be ruled out. Several less common pathologic entities also cause hemorrhage from the gastrointestinal tract. History of ulcer, roentgenography of the gastrointestinal tract, proctorectosigmoidoscopy, palpation of the abdomen and other procedures will be helpful in the exclusion. The x-ray finding of Meckel's diverticulum is rather incidental at examination of the gastrointestinal tract, and some authors do not consider an attempt justifiable. In some cases, however, there may be clinical evidence of Meckel's diverticulum in the operative records of a previous laparotomy and those in which Meckel's diverticulum was found incidentally on previous roentgenographic examinations of the gastrointestinal tract. Abnormalities of the umbilicus may in some cases be the only evidence to suggest Meckel's diverticulum.

Meckel's diverticulum occurs twice as frequently in males as in females [*15*]. Not only quantitatively is the male more burdened by Meckel's diverticulum, but also even the hemorrhages occur with greater frequency in the male. Babcock says: "Males during the first year of life or before puberty are especially affected."

In the material of Söderlund [*17*] concerning all pathologic remnants of the omphalomesenteric duct, there were seventy-nine boys and thirty-six girls. With regard to pathogenic Meckel's diverticulum, generally speaking, forty-seven were found in boys and seven in girls. In other words, Meckel's diverticulum was the cause of disease seven times more frequently in boys than in girls. Her series include fifteen cases of ulcer of Meckel's diverticulum, thirteen in boys and two in girls. In eight cases in this series perforation occurred. The main symptom was hemorrhage, which was present in all seven patients with non-perforated ulcers and in four of the eight with perforation. Of the eleven patients with hemorrhage, tarry stools were noted in four; the remaining seven had a discharge of red blood. The loss of blood in two cases was appreciable; the hemoglobin fell to 33 and 35 per cent. In five cases the hemorrhage was unaccompanied by other symptoms.

Although Meckel's diverticulum is not uncommon as a source of hemorrhage among infants and children, it is a rarity in adults. In spite of this it should be taken into consideration. One of two cases described by Borgström and Ekman [*7*] was a thirty year old woman with repeated hemorrhages. Although after thorough examination no cause of hemorrhage had been established, laparotomy was performed on the suspicion of Meckel's diverticulum. In this case there was an ulcer, but heterotopic mucosa was not demonstrable.

The therapy of bleeding Meckel's diverticulum is surgical removal of the diverticulum itself or with resection of a part of the ileum. The latter procedure is preferable because the heterotopic mucosa is occasionally located in the ileum close to the base of the Meckel diverticulum.

CASE REPORTS

CASE 1. The patient was a three year old boy, who had never before been sick. Several weeks before admission to this hospital, during a seige of chicken pox, there was a sudden, moderately severe hemorrhage in the stool. Seen the following day after another hemorrhage, the boy was found to be pale, moderately listless and in shock. He was sent to the Cook County Contagious Hospital, where he responded to blood transfusion and general care with apparent cessation of hemorrhage. Proctoscopic examination and blood work-up revealed no abnormalities. He returned home after one week.

Repeat blood work-up in this hospital was normal. The report of the gastrointestinal x-ray series at that time in this hospital was as follows: "A study of the G.I. tract fails to show any evidence of an organic lesion. I see nothing to explain this patient's bleeding from the G.I. tract."

No further hemorrhage was noted until 10 A.M. on the admission day, the twelfth day after x-ray examination, when the child again went into shock, which was followed by melena and grossly bloody stools. At admission examination the patient was a well developed, well nourished three year old boy with marked pallor yet quite alert and in no apparent pain. The cardiac rate was 140. The abdomen was moderately distended, with apparently some slight tenderness in the lower half. Bowel tones were moderately pitched. There was no rigidity or masses. The red blood cell count was 3,940

per cu. mm., the white blood cell count 25,300 per cu. mm., hemoglobin 75 per cent and hematocrit 25.5 per cent.

Five hundred cubic centimeters of whole blood and 250 cc. of plasma were given.

Operation on suspicion of bleeding Meckel's diverticulum revealed the following: There was a walnut-sized mass adherent to the anterior surface of the ileum, about 2 feet proximal to the cecum, near the border of the ileum, and connected with the umbilicus by a firm fibrous cord. The mass was acutely, and in part translucently, edematous, with a small vascular mesentery of its own, adherent to the mesentery of the ileum.

The Meckel diverticulum was removed after opening to be sure that there was no area of ulceration in the ileum itself. Pathologic report revealed the following: Grossly, the Meckel diverticulum measured 5 by 2 cm. It showed thickened mucosa and grossly there was no evidence of an ulcer unless perhaps it was at the cut margin and could not be recognized at this tissue. Microscopically, section revealed a typical gastric mucosa which in one area showed a thinning of the epithelium with an infiltration of inflammatory cells, suggestive of an acute ulceration.

On the fourth day after operation the patient's first stool was tarry. Subsequently the stools were normal. The child was discharged in good condition the seventh day after operation.

CASE II. This case is much more interesting because of the age of the patient, who was a seventy-three year old, very obese woman. She had been operated upon successfully six years previously for choledocholithiasis. The patient had a history of two periods of painless hemorrhage from the rectum several years before, but these were not serious and she had not consulted any doctor.

The patient had severe, painless hemorrhage from the rectum for one week prior to the present admission. Seen at the onset by a doctor, she had refused hospitalization. On the day of admission the patient fainted at home.

On admission examination, bright red blood was noted coming from the rectum. The abdomen was soft, with no tenderness or pain. Immediate rectosigmoidoscopy to 22 cm. was done. No source of hemorrhage was found in this area. The hematocrit was 21 per cent, the white blood cell count 11,700 per cu. mm. and hemoglobin 49 per cent. Several transfusions of whole blood were given.

An emergency operation was performed and a Meckel diverticulum was found 80 cm. from the ileocecal junction. There was blood in the small bowel distal to the diverticulum, but none above it. The stomach and duodenum were normal to palpation. An incision was made in the taenia coli and endoscopy of the colon was done with the rectosigmoidoscope. No bleeding point was found. Resection of the Meckel diverticulum with a part of ileum and side-to-side anastomosis was done.

The patient had no further hemorrhage postoperatively. She died on the ninth postoperative day with signs of septicemia. No autopsy was performed.

The pathologic report was as follows: Grossly, the specimen consisted of a piece of bowel, 4 cm. in length and 3½ cm. in circumference. There was one black area 2½ by 1½ cm. which extended from the mesenteric surface of the mucosal side; this was also black and had a thinned area. Microscopically, there was destruction of most of the mucosa lining the bowel and there were also areas of hemorrhage. Diagnosis: Meckel's diverticulum with hemorrhage.

COMMENTS

Many surgeons surely can recall cases of intestinal hemorrhage without history of ulcer for which no explanation was found. Repeated examinations of the gastrointestinal tract during the hemorrhage period and even several months afterward were negative. Possibly in many of those cases the source of hemorrhage was a Meckel diverticulum. This source of hemorrhage, however, a rarity in adults, should be taken into consideration in every case of unexplained hemorrhage from the gastrointestinal tract.

The author fully supports the opinion of Borgström and Ekman that in unexplained hemorrhage from the gastrointestinal tract laparotomy is indicated on the suspicion that Meckel's diverticulum may be the source of hemorrhage.

The mention in operative reports of incidental findings of a "healthy" Meckel's diverticulum is imperative. It might in the future help to solve possible diagnostic problems.

SUMMARY

On the general basis of the question concerning the bleeding Meckel diverticulum, two cases of such a hemorrhage are described. The first patient was a three year old boy who had two periods of hemorrhage. The first hemorrhage occurred during a seige of chicken pox and the other several weeks later. In this case gastric mucosa was found in the Meckel diverticulum and the picture suggested an acute ulceration.

The other case, that of a seventy-three year old woman, is a rarity. This patient had previously had two periods of hemorrhage several years before, and was hospitalized because of the third one. The mucosa of the Meckel diverticulum was ileal and there were areas of hemorrhage without ulceration.

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Excision of Acute Pilonidal Cyst Abscess

A PRELIMINARY REPORT

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THE dictum, "Where there is pus it must be evacuated," has stood the test of time, unaltered, for centuries. Incision and drainage of an acute suppurative abscess therefore became axiomatic. The immediate pathologic condition was dealt with but the definitive care of the underlying process was postponed until such surgery would be feasible. In essence, the length of time from initiation of the morbid process to its culmination was not materially reduced. Stage procedures were the *modus operandi* for most such conditions and still are in some cases.

In the 1930's a group of surgeons in Boston performed cholecystectomy for acute cholecystitis. This procedure met with criticism for some time but later became an accepted technic by most. During World War II, with the wider use of chemotherapeusis and the introduction of antibiotics, excision of carbuncles rather than incision and drainage was being performed by many surgeons. The results were most gratifying. Presently, recurrent episodes of acute diverticulitis of the sigmoid colon are being treated more boldly. Resection of the diseased segment of bowel with end-to-end anastomosis rather than stage procedures is being popularized and getting very favorable comment.

From a physiologic standpoint, the treatment of acute suppurative disease would appear to be simple incision and drainage. The possibility of opening new lymph channels and blood vessels with consequent dissemination of septic material, theoretically is omnipresent, and precludes definitive surgery. In actual practice, however, such does not appear to be the case. Of course a case of distant sepsis will be reported, but this can happen where incision and drainage are performed rather than excision. Examples of this have been seen when osteomyelitis of bone developed following incision and drainage of a furuncle several weeks previously. What has materially reduced the possibility of sepsis are most assuredly the use of antibiotics pre- and postoperatively, and more careful surgery.

Acute suppurative abscess in pilonidal cysts is fairly common. In the Armed Services it constitutes a really notable problem. The 1956 Year Book of Surgery reports the number of man days lost to be considerable. Any method which would improve this situation would be most welcome.

From the foregoing observations I believed that a more aggressive approach could be attempted in the treatment of acute suppurative abscess in a pilonidal cyst. I elected to perform a primary excision of the abscess and cyst in 1955. To date this operation has been performed upon six patients. The results are most encouraging. Although the series is small, the uniformly good results obtained so far have made me feel the procedure worthy of reporting.

There were four men and two women in the series. They ranged in age from seventeen to twenty-eight years. All patients were in good health except for the abscess. Some had had previous incision and drainage. For some this attack was the first. All patients had been receiving antibiotic therapy for several days prior to hospital admission, in most cases from five days to one week. All patients were hospitalized immediately after having been seen and were operated upon as soon as preliminary preparations were completed for surgery. Spinal anesthesia, 100 mg. procaine, was used in all cases and the patients assumed the prone position on the operating table.

The operative procedure consisted of the following: An elliptic incision, wide of the in-

flammatory border, was made on both sides of the abscess over the sacrococcygeal region. The incisions were carried down to the sacrococcygeal fascia. More often than not, the abscess was opened inadvertently. This necessitated wider saucerization of the area. The entire abscess, cyst and tracts were excised *en masse* where possible. Hemostasis was secured by ties of plain No. 00 catgut or suture ligatures. The area was irrigated with warm saline and the cavity packed with vaseline gauze packing. A moderately firm compression dressing was also applied over the packing.

Postoperative care consisted of the use of ½ gr. codeine and empirin tablets for pain; 300,000 units of penicillin combined with ½ gm. dihydrostreptomycin given by intramuscular injection twice daily; and urecholine® tablets, 10 mg. four times a day, until the patient voided. All patients were permitted bathroom privileges as soon as the anesthesia had worn off. Dressings were not disturbed for seventy-two hours. All packing was then removed and the patient was advised to take warm sitz baths three times a day, or more often as desired. Diet was not restricted. On the fifth postoperative day, discharge from the hospital was effected. Further follow-up care resolved itself in the care of an open granulating wound. Particular attention was paid to shaving the edges of the wound frequently.

The temperature in all cases dropped to normal abruptly after surgery. Relief of pain was dramatic and need for narcotics was minimal. All wounds healed completely in four to six weeks. Most patients resumed their work or duties in ten to fourteen days postoperatively. I should like to note that these wounds seemed to heal more cleanly and quicker than those which resulted when excision was performed for a chronic draining pilonidal cyst and the wound left open to granulate. Could it be that an acute suppurative process stimulated better local healing powers?

SUMMARY AND CONCLUSIONS

The rationale of excision of acute pilonidal cyst abscess is discussed, and in this preliminary report the results of six cases are presented. No recurrence of either infection or cyst has appeared since this operative procedure was adopted, that is, over a period of from four to twenty months. With the help of antibiotics pre- and postoperatively, excision should be given serious consideration.

SURGICAL REVIEW

Aneurysm of the Renal Artery

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ANEURYSM of the renal artery is considered to be a rare lesion. However, since about one-third of all the cases recorded in the world literature have been reported within the past five years, one wonders whether or not this lesion is really as rare as the literature suggests. I became interested in this lesion of the renal vessels when I was fortunate enough to have had personal contact with two patients having such lesions within the space of one year. One of these cases has been previously reported in detail by this author and co-workers [*1*], and the other by several colleagues [*2*].

Rouppe was the first to discover an aneurysm of the renal artery in 1770 [*3*]. The last comprehensive review of the subject by Abeshouse [*4*] appeared in 1951. In this report the number of aneurysms of the renal artery was brought to 115; however, I found three other cases occurring before 1951 not included in Abeshouse's review [*5–7*]. Since then fifty-four additional cases have appeared in the literature, thereby bringing to 172 the total number of aneurysms of the renal artery reported. Vest has also very kindly informed me of still another case not appearing in the literature, and Norfleet has graciously supplied information relative to two more cases to be reported in the literature at a later date. There are undoubtedly other unreported records of aneurysm of the renal artery lying dormant in hospital file rooms.

Classification. As noted in Abeshouse's able review, aneurysm of the renal artery may be classified as saccular, fusiform, dissecting or arteriovenous in type. The saccular arterial aneurysm is the most common type, being formed as the result of a localized outpouching which communicates with the lumen of the artery by a narrow or wide opening. This type of aneurysm is usually 1 to 2 cm. in diameter, but sizes of 10 to 12 cm. in diameter have been reported. The larger aneurysms may be palpable and may transmit a pulsation or systolic bruit. In the fusiform aneurysm there is a fairly uniform dilatation of a portion of the artery, varying from 0.5 to 1 cm. in length. Abeshouse noted only four reports of this type of involvement. The dissecting aneurysm rarely involves the renal artery. Abeshouse could find only three reports of this type of lesion which consists of an extensive extravasation of blood passing up and down the media of the artery, thereby separating this coat into two layers. A fourth case appeared in the literature in 1956. The arteriovenous aneurysm of the renal artery is also rare; only ten cases have been reported [*1,5,7–13,56*]. One of these [*8*] is included in Abeshouse's report. The lesion consists of a direct shunt between an aneurysmally dilated artery and vein, and may be extra- or intrarenal in location. In two of the cases reported the lesion was of the intrarenal type [*12,13*].

Six cases of arteriovenous fistulas of renal vessels without evidence of arterial aneurysm formation have also been reported in the literature and are mentioned here simply for the sake of completeness in a review of this type. They are therefore not included in the total number of cases of aneurysm of the renal artery. Hollingsworth [*14*] reported a case of arteriovenous fistula of renal vessels suspected on the basis of a left lumbar bruit and thrill noted about eighteen months after a nephrectomy had been performed. The patient refused

a second operation and the lesion was therefore not proved. A postnephrectomy arteriovenous fistula of renal vessels was reported by Schwartz et al. [*15*] in 1955, and another by Muller and Goodwin [*16*] in 1956. Both cases were demonstrated by translumbar aortography, proved at operation, and revealed dilatation of the venous ends of the fistulas, while the arterial ends were thought to be normal. Muller and Goodwin also mentioned a case reported by Vest in which a similar lesion occurred after nephrolithotomy. Another case of arteriovenous fistula, demonstrated by transfemoral aortography, was proved at operation to be due to renal carcinoma [*17*]. No arterial dilatation was noted in this case, nor in a similar case noted by Hamilton et al. [*18*].

Aneurysms of the renal artery may also be classified as true or false in type. The true aneurysm is described as a localized dilatation of the renal artery retaining one or more of the original arterial coats. In the false aneurysm the walls are derived from tissues surrounding the artery, such as organized blood clot, renal capsule, connective tissue or fascia, perirenal fat or peritoneum. False aneurysms are considerably larger than true aneurysms, and may vary in size from one of 10 cm. in diameter to that of a mass occupying half the abdomen. They may result from the spontaneous or traumatic rupture of a pre-existing true aneurysm, or of a normal or diseased renal artery. Abeshouse noted thirty-five false aneurysms in his review. Since 1951 only three aneurysms were described as being of the false type. While calcification of the walls is common in the true aneurysm, it is rarely noted in the false type.

Etiology. As already well described by Abeshouse, the etiology of renal artery aneurysms may be due to congenital or acquired causes. The occurrence of aneurysms at the bifurcation of the renal artery or at the point of arterial branching may be compatible with congenital formation such as occurs in vessels of the brain. However, the theory of congenital formation is not readily explained when one realizes that in only sixteen cases was the lesion found at or near the renal artery bifurcation; that the majority of cases reported showed no evidence of other visceral arterial involvement; and that the lesion was found relatively infrequently in young individuals. Most of the arteriovenous aneurysms, however, were thought to have been congenital in nature.

The acquired lesions may be the result of degenerative, inflammatory or traumatic changes involving the arterial walls. The degenerative changes may include sclerosis, fatty and hyaline degeneration, atheromatous plaque formation, etc., with subsequent medionecrosis and aneurysm formation. Abeshouse lists only sixteen cases which may be ascribable to arteriosclerosis, and I have noted only five more in which generalized arteriosclerosis was present. The importance of degenerative changes has not been established; however, in thirty-five of the fifty-seven cases noted since 1951 calcification of the aneurysmal sacs was present, and atherosclerotic changes were found within two other aneurysms. It is difficult to state, therefore, whether or not localized degenerative changes had already occurred prior to aneurysm formation in these cases.

Inflammatory lesions involving the renal artery are infrequent. Abeshouse lists only nine cases being secondary to syphilis, periarteritis nodosa, rheumatic endocarditis or tuberculosis. Systemic diseases accompanied with septicemia or bacteremia may play a role in the etiology of aneurysms of the renal artery. In several of the cases reported the patients gave histories of subacute bacterial endocarditis, pneumonia, malaria, typhoid fever, dysentery, rheumatic fever and chronic nephritis. Ulcerative endarteritis with necrosis and dilatation of the arterial wall can occur after septic emboli lodge in the vasa vasorum. Rupture of the vasa vasorum, or intimal tears as the result of the presence of atheromas, may cause the dissecting type of aneurysm.

Several associated lesions have also been noted in conjunction with aneurysm of the renal artery, and these include calculous pyonephrosis, calculi, acute or chronic nephritis, hydronephrosis, horseshoe kidney, adenoma and hypernephroma.

Trauma was a major factor in the formation of aneurysm of the renal artery in only a few cases. Abeshouse mentions three occurring as the direct result of trauma, and two more following surgical procedures on the kidney. One other case directly due to trauma has been reported since 1951. In thirty-three other cases trauma was noted in the histories for varying periods of time prior to the discovery of the aneurysms, but the role played by the traumatic occurrences in the formation of the

aneurysms is not definite: Certainly it is possible that aneurysms may occur as the late sequelae of traumas which have involved the kidney or vascular supply directly or indirectly.

Complications. Complications resulting from aneurysm of the renal artery include various degrees of renal changes, secondary cardiovascular abnormalities and rupture of the aneurysm with subsequent hemorrhage. No renal changes may occur in the presence of small aneurysms, and renal function may be undisturbed. Larger aneurysms may cause pressure necrosis of surrounding or adjacent renal parenchyma, partial obstruction of the pelvocalyceal system, or a partial or complete obstruction of the renal artery itself. Compromise of the renal vascular supply may lead to renal ischemia with various stages of atrophy, and hypertension. The Goldblatt phenomenon was mentioned in seven cases [*2,11,19–22*]. Five of these patients were relieved of hypertension by nephrectomy [*2,11, 19,20,22*], but in the other two cases, in both of which the patients were suffering with periarteritis nodosa, the renal artery lesions were discovered at autopsy [*21*]. Hypertension was also noted in thirty-four other cases, and in several of these the patients experienced varying degrees of relief of the hypertension following nephrectomy. Four other patients demonstrated only slight to moderate elevation of the systolic pressure. In one of these the systolic pressure returned to normal after resection of the aneurysm, and in the other, with arteriovenous aneurysm, the systolic pressure also returned to normal after nephrectomy. The two remaining patients were not operated upon. Cardiac enlargement, with failure and exertional dyspnea, as noted in three of the cases of arteriovenous aneurysm, was also relieved by nephrectomy.

Rupture of an aneurysm of the renal artery should always be considered as an important, and even a fatal, complication. The resultant hemorrhage may be retroperitoneal, intraperitoneal, intrarenal or intrapelvic in location, depending on the site of the aneurysm. False aneurysms, therefore, can be more dangerous than those of the true type, and the extravasation of blood occurring in the formation of a false aneurysm may be severe with rapid mass formation. Exsanguination, shock, collapse and death have been noted in several instances of false aneurysm formation. However, the hemorrhage may become encapsulated by surrounding tissues with the organization of blood clot. Abeshouse mentions sixteen fatalities following rupture of aneurysms of the renal artery, with four of these occurring in pregnant patients. Since 1951 eight more cases of rupture of aneurysms of the renal artery have occurred. Of these, four patients were cured by nephrectomy (one being pregnant), and four cases terminated fatally, having been unaided by laparotomy (two patients being pregnant).

Occurrence. Aneurysm of the renal artery has occurred in eighty-eight females and in seventy-three males; in fourteen cases the sex was not stated. The youngest patient was nine months old and the oldest was eighty-two years of age. The lesion occurred on the right side in eighty cases, on the left in eighty-one cases and bilaterally in four more cases; in ten cases the side was not stated. The lesion also involved the main renal artery in ninety-two cases (being at or near the bifurcation in sixteen cases), while extrarenal branches were involved in forty-four cases and intrarenal branches in fifteen cases. A superior polar accessory artery was involved once, an inferior polar accessory artery once and the intrarenal portion of an accessory artery once. In three cases a multilocular aneurysm of the renal artery was found, one of these being intrarenal in location and included heretofore. In twelve cases location of the aneurysm was not definite. More than one aneurysm was found in several other cases (excluding the bilateral aneurysms already mentioned). Abeshouse collected four cases, each with two aneurysms on the same side, and a fifth case with four aneurysms on the same side. Since then, a case having two aneurysms on the right side, and also an additional case revealing two aneurysms of the left renal artery (one of which ruptured) have been reported. This latter case was one of the three cases of rupture cured by nephrectomy as previously mentioned.

Symptoms and Signs. The symptoms and signs of aneurysm of the renal artery vary with the size and type of lesion present, and may include pain, tenderness, hematuria, hypertension, and the presence of a mass, bruit or palpable pulsation. Small aneurysms, however, may be completely asymptomatic. Pain was mentioned in a total of ninety-three cases, although the pain was not necessarily due to the presence of the aneurysm. In many cases,

associated diseases such as renal lithiasis, cholelithiasis or renal infection could have explained the pain. Tenderness was present in relatively fewer cases, but here again the significance of this finding should be considered in the same light as pain. Hematuria, which was mentioned in fifty cases, may be profuse or minimal in quantity, and continuous or intermittent in character. It may occur as the result of intrarenal or intrapelvic rupture of, or erosion by, the aneurysmal sac, and at times may be the only sign of the presence of a vascular abnormality. Hematuria may also be due to associated renal disease or to the presence of renal infarcts occurring as the result of vascular thromboses secondary to the presence of the aneurysm. Hypertension was noted in a total of forty-one cases, and the effect of the nephrectomy on hypertension has already been mentioned. The presence of a mass was noted in relatively few cases, and a bruit or pulsation was noted in only seventeen cases, with six of these cases revealing a bruit in the presence of arteriovenous aneurysms.

Diagnosis. The diagnosis of aneurysm of the renal artery may be quite difficult, particularly if the lesion is small and asymptomatic. The most reliable signs include the presence of calcification noted in the renal area on roentgenographic examination of the abdomen, or the presence of a suspicious bruit, thrill or palpable pulsating mass as already mentioned. However these latter signs occurred infrequently.

Renck [*23*] was the first to publish the roentgen signs of aneurysm of the renal artery in 1926. He described a round or oval calcific ring shadow representing calcification within the walls of the aneurysm. As described by Renck, the shadow possesses a well defined periphery with an increased density as compared to a less opaque central region, and with an occasional loss of continuity at a point where the aneurysmal sac is said to communicate with the renal artery. In addition, the calcific shadow is usually located in the region of the renal hilum, and outside of or adjacent to the renal pelvis, such that a resultant impression on the pelvis or calyces may occur. This sign was present in sixty-four of 175 cases. In thirty-one of these cases listed by Abeshouse only twenty-five were interpreted correctly before operation. In the thirty-three cases demonstrating this sign since 1951, thirty were interpreted correctly while two were thought to represent aclyceal calculi, and the other was interpreted as calcification in a cyst or tumor. Several of the cases presenting the ring sign also revealed defects involving the adjacent pelvocalyceal system as noted on intravenous urography or retrograde pyelography. The absence of the ring shadow does not preclude the possibility of an aneurysm. Several cases did not present this sign. Of the cases reported since 1951, seven revealed pressure defects of the renal pelvocalyceal system without evidence of vascular calcification.

The calcific ring shadow must be differentiated from urinary or biliary calculi, calcified cysts or neoplasm of the kidney or adrenal gland, or calcified tuberculomas, abscesses, or hematomas in or near the kidney, and calcified mesenteric nodes. All these lesions in general possess calcific deposits of a roentgen appearance peculiar to the type of lesion present and different from the calcification of an aneurysmal sac. Differentiation of the calcified aneurysm of the renal artery from calcified aneurysms of the splenic, hepatic, pancreatic or mesenteric arteries may be difficult. However, the location of the calcific ring shadow of the renal artery aneurysm will be important in this differentiation.

The diagnosis of aneurysm of the renal artery will be simplified by the use of abdominal arteriography. Abeshouse was the first to demonstrate an aneurysm of the renal artery by aortography using the transfemoral method such as described by Peirce and Ramey [*24*], and this method was also used more recently in the case of a nine month old infant. The translumbar method already well described in the literature [*25*] was used in twenty-two other cases. In ten of these there was no prior roentgen evidence of the calcific ring shadow; however, two did demonstrate pelvocalyceal defects on urography. In one case the aortogram was considered as "giving no useful information." The reason for this was not stated. In still an additional case, a renal artery aneurysm was diagnosed during operation by renal arteriography [*26*].

Treatment. Aneurysm of the renal artery can be treated only by surgical intervention, which in the majority of cases will mean nephrectomy. Operation should be prompt in the case of the unruptured aneurysm, and may be life saving in the case of the ruptured lesion.

Of the 175 cases reported, fifty-five patients were not operated upon for various reasons, and of these, death occurred in forty-nine cases after varying periods of time. No information is available relative to the final status of the remaining six patients. Surgical procedures were performed on 120 patients, and of these, ninety underwent nephrectomy. Only four mortalities were noted after this procedure, and three of these were listed by Abeshouse. Successful aneurysmectomy without nephrectomy could be accomplished in only nine cases, with no mortalities noted. Other conservative surgical procedures, as noted by Abeshouse, were performed in five cases without fatalities, and these included evacuation of the clot from the aneurysm with repair, denervation of the renal pedicle with nephropexy, renal decapsulation, release of adhesions between the aneurysm and the kidney, and an exploratory laparotomy. In Vest's case the aneurysm was wrapped in sclerosing cellophane to prevent rupture of the lesion and also to spare the kidney. Removal of a postnephrectomy arteriovenous aneurysm was mentioned by Poutasse [*56*].

Conservative procedures such as partial excision or incision and drainage of the lesion and exploratory laparotomy were performed in thirteen other cases, all of which terminated fatally as the result of hemorrhage. In another fatality in which adrenalectomy was performed, the aneurysm was found at autopsy.

It becomes evident, therefore, that once an aneurysm of the renal artery is diagnosed, surgical intervention is of paramount importance. Of course, the function and condition of the opposite kidney should always be evaluated preoperatively. Severe disease of the opposite kidney would obviously preclude nephrectomy on the involved side, and every attempt would be made to use more conservative procedures in treating the lesion.

PREVIOUS REPORTS OF ANEURYSM OF THE RENAL ARTERY

Abeshouse (1951) reported on 115 cases. Ages: nine months to eighty-two years; sex: fifty-five males, fifty-three females and seven not stated; side: fifty-one on right, fifty-four on left, one bilateral and nine not stated; type: eighty true and thirty-five false; location: sixty-six in main renal artery, forty-two in branches, one in accessory renal artery, five with more than one aneurysm and one not definite. Pain was noted in sixty-three cases, hematuria in forty-one, a mass in thirty-one, tenderness in twenty-two, hypertension in nineteen, bruit in six and pulsation in six. A calcific ring shadow was noted on roentgen examination in thirty-one cases, and the author proved one case by aortography. Operation was performed in sixty-eight cases (fifty-one nephrectomies) while forty-seven patients were not treated. Of the untreated, forty-five patients died. There were twelve postoperative deaths. The remainder of the treated patients were cured.

Varela (1928) reported on a twenty-eight year old man with a true arteriovenous aneurysm of the right main renal artery, of probable congenital origin. A murmur in the right lumbar region and blood pressure of 160/80 were present. No roentgen findings were available, there was no treatment and the lesion was proved at autopsy.

Waegener (1931), as reported by Burket, found a case of a thirty-nine year old man with a true aneurysm of a branch of the left renal artery. The lesion ruptured and the patient noted abdominal pain and vomited. Retroperitoneal hemorrhage was found at laparotomy. The patient subsequently died. No roentgen findings were available.

Rieder (1942) reported on a twenty-four year old woman with a true arteriovenous aneurysm of the right main renal artery, of probable congenital origin. There was a history of trauma. Thrill and bruit in the right lumbar region, cardiac enlargement, dyspnea and blood pressure of 220/110 were noted. A pelvocalyceal defect was noted on urography. After nephrectomy the blood pressure became normal and the patient recovered.

Adams (1951) reported a true arteriovenous aneurysm occurring in an adult, involving the right main renal artery. Nephrectomy was performed, followed by recovery. No other information was given.

Burket (1952) reported on a forty-one year old woman with a true aneurysm involving the bifurcation of the right renal artery. There was a history of pneumonia, and pain in right upper quadrant of the abdomen and the lumbar region. A calcific ring shadow and deformed renal pelvis were noted on x-ray film. Nephrectomy was performed, followed by recovery.

Zummo et al. (1952) reported on a twenty-

four year old woman with an aneurysm of the left main renal artery, type not stated. Rupture of the lesion caused abdominal pain and retroperitoneal hemorrhage. The patient was seven months pregnant; she underwent laparotomy but died.

Salmon et al. (1953) reported on a fourteen year old girl with a true aneurysm of the right main renal artery, with rupture. Abdominal pain, hemorrhage, shock and hematuria occurred. There was a history of tuberculosis. The patient died during laparotomy.

Shapiro (1953) reported on a sixty-five year old woman with a true aneurysm of the right main renal artery, and with right upper abdominal pain. A calcific ring shadow was noted on x-ray film. The lesion was shown by aortography. Nephrectomy was performed, followed by recovery.

Hughes (1953) reported on a forty-two year old man with a true aneurysm of an extrarenal branch of the right renal artery. There was a history of horseback-riding injury and left lumbar pain. A calcific ring shadow was noted on x-ray film. The lesion was shown by direct arteriography during operation. Nephrectomy was performed, with recovery.

Von Ronnen (1953) described two cases. One patient was a sixty-two year old woman with a true aneurysm of the right main renal artery, suffering with right-sided back pain and arteriosclerosis. A calcific shadow was seen on x-ray examination. Nephrectomy was performed with recovery.

The second case involved a seventy-four year old woman with a true lesion of the right renal artery, with left lumbar pain and arteriosclerosis. A calcific shadow was seen on x-ray film. The patient refused operation.

Baker and Huckleberry (1953) reported on a twenty-four year old woman with a true aneurysm of an intrarenal branch of the left renal artery, with rupture. There was a history of painless hematuria and of previous delivery of twins. The middle calyx was seen compressed on urography. Nephrectomy was performed, followed by recovery.

Chamberlin and Hovenanian (1953) reported on a forty year old man with a true aneurysm of the accessory renal artery to the lower pole of the left kidney. Dull pain in the left upper quadrant of the abdomen was noted. A calcific shadow was seen on x-ray film. Nephrectomy was performed, followed by recovery.

Hack (1953) described a thirty-three year old woman with a false aneurysm of the left main renal artery, with rupture. The patient was pregnant for the fourth time, at thirty weeks' gestation. Hemorrhage, severe pain in the left upper quadrant and shock occurred. There were no roentgen signs. Laparotomy was performed, followed by death. Calcified plaques were noted in the lesion on autopsy.

Pelot et al. (1954) recorded the case of a twenty-six year old man with a true anteriovenous aneurysm of an extrarenal branch of the right renal artery. There was a history of a gunshot wound in the abdomen. The blood pressure was 210/130. Goldblatt's phenomenon was mentioned. Roentgen evidence of a pelvocalyceal defect was noted. Nephrectomy revealed renal atrophy. The patient recovered, the blood pressure becoming 130/75.

Goldfarb and Tankin (1954) reported the case of a fifty-seven year old woman with a true lesion of the right main renal artery. Arteriosclerosis, epigastric pain and indigestion were noted. There was a calcific ring shadow on roentgen study. Nephrectomy was performed, followed by recovery and relief of symptoms.

Antipa (1954) reported on a fifty-seven year old woman with a true aneurysm at the bifurcation of the left main renal artery. She had left-sided colic, bloody urine, a blood pressure of 174/112, and a calcific ring shadow with pelvic defect on urographic study. Nephrectomy was performed, with recovery. The blood pressure dropped slightly to 160/90.

Leger et al. (1954) described a fifty-three year old woman with a true aneurysm of the right main renal artery. She had pain in the right upper quadrant and the lumbar region, and chronic pyelitis; the blood pressure was 186/106. A calcific ring and pelvic defect were noted on urography. Aortography revealed the lesion. Nephrectomy was performed, with recovery but no change in blood pressure.

Atkinson (1954) reported on a sixty-seven year old woman with a true aneurysm of the left main renal artery, having backache, blood pressure of 220/160 and calcific ring shadow on x-ray examination. Nephrectomy was performed, with recovery and slight decrease in blood pressure.

Schulze-Bergmann (1954) described a case of a fifty-nine year old woman with a true arteriovenous aneurysm of the right main renal artery, of probable congenital origin.

Renal colic and bloody urine were present. A pelvic defect was noted on urography and the lesion was shown by aortography. Nephrectomy was performed, followed by recovery.

Baron and Koenemann (1955) recorded the case of a seven year old girl with a true arteriovenous aneurysm of an intrarenal branch of the left renal artery, lower pole, with a history of deep stab wound, left loin, five months prior to discovery of the lesion, headaches and blood pressure of 146/100. A pelvocalyceal deformity was noted on x-ray. Nephrectomy was performed, with recovery and blood pressure of 120/80.

Del Pobil y Bensusan (1955) reported the case of a thirty-seven year old woman with a true aneurysm of an extrarenal lower pole branch of the left renal artery, left lumbar pain, history of injury and lower pole urographic defect. Nephrectomy revealed an atrophic kidney. The patient recovered.

Curbelo (1955) reported on a thirty-three year old woman with a true aneurysm of the right renal artery, left lumbar pain, history of pyelonephritis on the left with previous nephrectomy, and calcific ring shadow on x-ray. Aortography revealed the lesion. No treatment was afforded.

Begner (1955) recorded the case of a forty-nine year old woman with a true aneurysm at the renal artery bifurcation on the left, left-sided back pain and calcific ring on x-ray. Aortography revealed the lesion which was removed by nephrectomy. The patient recovered.

Saegesser and Pahud (1955) reported on a fifty year old man with a true lesion of an intrarenal branch of the right renal artery, with rupture. Bloody urine and abdominal pain were noted. There were no roentgen signs. Nephrectomy was performed, followed by recovery.

Hock and Jones (1955) reported on an eight year old girl with a true aneurysm of the right main renal artery. There was a history of an old injury to the right flank. Goldblatt's phenomenon was mentioned. The blood pressure was 150/115 to 220/180. Roentgen study revealed two calcific rings and a non-functioning kidney. The child recovered after nephrectomy, with a blood pressure of 95/60.

Pastor et al. (1955) recorded the case of a thirty-six year old man with false aneurysm of the right main renal artery, intermittent pain in the right flank, arterial occlusive disease, Goldblatt's phenomenon, blood pressure of 210/116 and pelvic defect on urography. Aortography revealed an unsuspected lesion. The patient was cured by nephrectomy, with a normal blood pressure being noted.

Cibert et al. (1955) described a fifty-nine year old man with a true aneurysm of an extrarenal branch of the left renal artery, left lumbar pain, calcific ring shadow on roentgen study, and recovery following nephrectomy.

Pitkänen (1955) reported the case of a forty-three year old man with a true aneurysm of the right main renal artery, blood pressure of 155/70 and pelvocalyceal defect on urography. A tumor was suspected. An aneurysm was found at operation and successfully resected. The man recovered, the blood pressure becoming 120/60.

Heidenblut (1955) reported on a sixty-six year old woman with a true aneurysm of the left renal artery, a history of diphtheria, left lumbar pain, dyspnea, previous colonic resection for carcinoma, blood pressure of 170/80 and a calcific ring on roentgenogram. No treatment was afforded.

Snyder et al. (1955) reported on a nine month old male infant with two true aneurysms of the upper and lower extrarenal branches of the right renal artery, with vomiting, blood pressure of 240/190 and hypertensive retinopathy. There had been a previous thoracotomy for suspected left hilar ectopic pheochromocytoma which was not found, and demonstration of the renal artery aneurysms by right femoral retrograde aortography. Nephrectomy was performed, with recovery and a blood pressure of 90/60.

Baurys and Wentzell (1956) described two cases. In one, a forty-six year old woman possessed a true aneurysm of an extrarenal branch of the right renal artery. There was epigastric pain, blood pressure of 204/104 and a calcific shadow on x-ray, which was thought to be a calculus. The aneurysm was successfully excised and the patient recovered, with no change in blood pressure.

The second case was that of a seventy-three year old woman with a true lesion of the left main renal artery. She had chronic back pain and arteriosclerosis, and a calcific ring was noted on x-ray film. No treatment was given.

Silvis et al. (1956) reported on a sixty-five year old man with a true aneurysm of the intrarenal portion of an accessory renal artery on the right, blood pressure of 180/100 and a

calcific shadow on x-ray examination. The patient recovered after nephrectomy, with normal blood pressure.

Burt et al. (1956) recorded the case of a forty-four year old woman with two true aneurysms of the left main renal artery (one aneurysm ruptured). She was in her eleventh pregnancy at thirty-one weeks' gestation and had hemorrhage, pain and shock. There were no roentgen signs. The patient recovered after nephrectomy. Atherosclerotic plaques were found in the aneurysm.

Nesbit and Crenshaw (1956) reported two cases. One involved a twenty-five year old woman with true aneurysms of the renal arteries bilaterally (two lesions), hypertensive retinopathy, headaches, cerebral vascular accident, blood pressure of 265/158, a history of previous bilateral sympathectomies and bilateral calcific rings noted on x-ray. There was no treatment. No autopsy was available after death.

The second case was that of a fifty-two year old woman with a true aneurysm at the bifurcation of the right renal artery, with right-sided abdominal pain, blood pressure of 170/105 and a calcific ring shadow on roentgen study. There was recovery after nephrectomy, with a slight decrease in blood pressure.

Slominski-Laws et al. (1956) reported the case of a nineteen year old girl with a true arteriovenous aneurysm of the multilocular type involving small intrarenal branches of the left renal artery, cardiac enlargement with failure, vascular bruit and a calyceal defect on urography. A lesion was shown on aortography. She recovered after nephrectomy.

Garritano et al. (1956) reported on a twenty-two year old man with true arteriovenous aneurysm of the left main renal artery, cardiac enlargement with failure, dyspnea, bruit in the left side of the abdomen, blood pressure of 180/60, and history of a fall and gunshot wound. There was demonstration of the lesion by aortography. The patient was cured by nephrectomy, with the blood pressure becoming normal.

Vest (1956) reported on a fifty-four year old man with a true aneurysm at the bifurcation of the right main renal artery, hypertension, dizziness, visual scotomas, and a calcific ring shadow with pelvic defect on urography. Cellophane was wrapped around the lesion at operation. There was recovery with no change in blood pressure.

Norfleet and Strawcutter (1956) reported two cases. The first case was that of a sixty-five year old woman with a true aneurysm of the left main renal artery, left-sided back pain and calcific ring shadow on roentgen study. Two splenic artery aneurysms and several tiny aneurysms of the right kidney were noted at the time of nephrectomy and splenectomy. The patient recovered.

In the second case the patient was a fifty-six year old woman with a true aneurysm of the left main renal artery, hypertension and calcific ring on x-ray film. Nephrectomy was performed with no change in blood pressure.

Gilfillan et al. (1956) reported a case of a forty-seven year old man with a false arteriosclerotic dissecting aneurysm of the left main renal artery, pain in the left flank, nausea, vomiting, abdominal distention, blood pressure of 195/120, hematuria, non-functioning left kidney and occlusion of the left renal artery noted on aortogram. Goldblatt's phenomenon was mentioned. Nephrectomy was performed, with recovery and blood pressure of 130/80.

Malisoff and Cerruti (1956) recorded the case of a thirty-one year old man with a true aneurysm of an intrarenal branch of the right renal artery. He gave the history of having been in an airplane crash in 1943; of having had abdominal pain and hematuria in 1946; severe pain in the right flank in 1950; and pyuria in 1954. A calcific ring and a pelvocalyceal defect were noted on x-ray film. Nephrectomy was performed, with recovery.

Burns (1956) reported on a four year old boy with true aneurysm of an extrarenal branch of the left renal artery, blood pressure of 180/100 to 220/150 and cardiac enlargement. An aortogram was not informative. Pheochromocytoma had been suspected. Laparotomy was performed with left adrenalectomy, followed by myocardial failure and death. An aneurysm was noted on autopsy.

Massachusetts General Hospital Case No. 42481 (1956): The patient was a seventy-four year old woman with a true arteriosclerotic aneurysm of an extrarenal branch of the right renal artery, painless hematuria, blood pressure of 190/90 and a calcified mass displacing renal calyx on urogram. A renal cyst or tumor was suspected. Nephrectomy was performed, with recovery.

Davidson and Coe (1956) recorded the case of a forty-seven year old woman with a true

aneurysm of the right renal artery which was partially obstructed. The patient gave the history of severe headaches, blurred vision, papilledema, hypertensive retinopathy and a period of convulsions. On examination there were bilateral Babinski's reflexes, blood pressure of 240/140, albuminuria, intermittent microscopic hematuria and elevated cerebrospinal fluid pressure (410 mm.). A urogram was normal. Eventually there was nuchal rigidity, bloody cerebrospinal fluid and death. An aneurysm was found at autopsy. Changes of renal ischemia were noted.

Ardanza (1956) reported on a sixty year old woman with a true aneurysm of an extrarenal branch of the left renal artery. She gave a history of left renal colic. Calcification on urogram was thought to be a parenchymal calcification. A calcified aneurysm was found and successfully excised, with preservation of the kidney, followed by recovery.

Poutasse (1957) has collected twelve cases, as follows: seven with saccular aneurysms (six calcified, of which one was bilateral), three post-stenotic "jet" type aneurysms, one non-calcified fusiform aneurysm associated with hypernephroma and one arteriovenous aneurysm occurring after nephrectomy. In one case with a saccular aneurysm a thirty year old woman was cured of hypertension by nephrectomy. Except for the untreated case of bilateral saccular lesions, the other five patients underwent nephrectomy, with one death occurring four days after operation as the result of probable internal carotid artery thrombosis. Of the three post-stenotic lesions, two patients were cured of malignant hypertension by nephrectomy (one of these ruptured), and one patient, in whom a calcified saccular aneurysm on the opposite side had been excised previously, has been placed on medical treatment for hypertension. The patient with the fusiform aneurysm and hypernephroma underwent nephrectomy successfully but died six months later of metastases. The arteriovenous aneurysm, with audible bruit, was excised in the remaining case. All the foregoing lesions were demonstrated by aortography. Three were present on the right, six on the left, two were bilateral, and in one the side was not stated.

SUMMARY

The literature relative to aneurysm of the renal artery has been reviewed. To date, the total number of aneurysms reported has reached 175. The fact that one-third of the cases have been reported within the past five years is undoubtedly the result of better diagnostic methods and the maintenance of a higher index of suspicion with respect to this lesion.

The most reliable signs in the diagnosis of aneurysm of the renal artery include the presence of the calcific ring shadow on roentgenographic examination of the abdomen, and the presence of a vascular bruit, thrill or pulsating mass in the abdomen. The use of abdominal arteriography is invaluable in the diagnosis of this renal vascular lesion.

The complications of renal artery aneurysm include renal damage, cardiovascular abnormalities and rupture of the lesion, which was fatal in twenty of the twenty-four cases in which this complication occurred. Hypertension, which was noted in forty-one cases, was relieved in many of these by nephrectomy. Other cardiovascular abnormalities noted in the presence of arteriovenous aneurysms were similarly relieved.

Once aneurysm of the renal artery is diagnosed, surgical intervention offers the only hope of cure. While death was noted eventually in almost all the untreated cases, only 14 per cent of the operated cases terminated fatally, with most of the deaths being due to hemorrhage. Only 4.5 per cent of the patients undergoing nephrectomy died, and operation was life saving in many instances. None died after aneurysmectomy.

Aneurysm of the renal artery is therefore an important lesion, and should always be considered in cases of unexplained hypertension or hematuria. It is hoped that this review will stimulate further interest in this renal vascular lesion so that more cases might be diagnosed which otherwise would be overlooked.

ADDENDUM

Since this paper was submitted for publication, five more reports of aneurysm of the renal artery have appeared in the literature. Smith and Erickson [57] reported a case of a forty-three year old woman who underwent nephrectomy because of the presence of an intrarenal arterial aneurysm in the right kidney, after intravenous urography demonstrated a calyceal pressure defect and the lesion was revealed by aortography. In a case reported by Bohne and Henderson [58], a sixty-three year old man

underwent nephrectomy because of the presence of a large calcified intrarenal arteriovenous aneurysm in the right kidney demonstrated preoperatively by aortography. Miller and Garvan [59] reported on a sixteen year old girl with a calcific ring shadow at the left renal hilum noted on roentgenography. A fusiform aneurysm of the left renal artery was found at nephrectomy and the patient was cured of hypertension. Debre et al. [60] reported on two children undergoing nephrectomy for aneurysm of the renal artery. In both cases the lesion was demonstrated by aortography. One six year old girl with a calcified lesion on the right had marked amelioration of her hypertension after nephrectomy, and a seven year old boy with a left-sided lesion was cured of hypertension after nephrectomy.

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Carotid Body Tumor

REPORT OF CASE TREATED BY RESECTION OF TUMOR AND CAROTID ARTERY FOLLOWED BY REPLACEMENT OF ARTERY WITH FROZEN DRIED GRAFT

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MOST tumors of the carotid body can be resected without sacrifice of the carotid artery, provided that the surgeon is willing to cut through the tumor, accept considerable bleeding from the spongy vascular tissue and dissect the tumor cleanly off the carotid vessels which as a rule are not invaded. Since most carotid body tumors are benign and do not implant themselves, this method of management is acceptable in the majority of cases. Occasionally, however, a carotid body tumor will actually invade the vessel in such a way that its removal is impossible without sacrifice of the vessel. When the carotid is sacrificed, hemiplegia may ensue.

As a protection against hemiplegia it is wise to have available an arterial graft for immediate replacement of the vessel.

CASE REPORT

A twenty-seven year old man had noticed a tumor in the neck for three years prior to admission. An operation had been performed a month before admission and the surgeon had encountered so much bleeding that he did not remove the tumor. Biopsy showed carotid body tumor and the patient was referred to the Cleveland Clinic for definitive surgery. The biopsy specimen of the previous operation was re-examined by John B. Hazard, M.D., and called non-chromaffin paraganglioma (chemodectoma or carotid body tumor).

At operation an incision was made in the neck just anterior to and paralleling the sternocleidomastoid muscle. There was considerable inflammatory reaction from the previous operation which rendered the dissection difficult. Hemostasis was secured by electrocoagulation of small vessels and ligation of larger ones. A firm mass, 7 by 4 cm., was found to encircle completely the common carotid artery and the proximal portions of the external and internal carotid. The left vagus nerve was lying just posterior to the mass and was not involved in the tumor itself. The internal jugular vein was lying on the anteromedial surface of the tumor, was adherent to it, and was clamped, divided and ligated both proximally and distally to the tumor. The mass was then freed from the proximal portion of the external and internal carotid arteries almost down to the bifurcation of the carotid. But, in an attempt to separate the tumor from the bifurcation, a rent was made in the carotid and it became apparent that there was actual invasion of the vessel wall at this point. The external carotid was then ligated and an attempt was made to repair the rent in the common carotid artery. This was found to be impossible because of the friability of the vessel and the fact that all coats except the intima appeared to be involved by the tumor. Bulldog clamps were then placed on the common carotid artery proximal to the tumor mass and again distal to it, and the mass was

excised. A dried frozen arterial graft, 2 inches in length, was inserted in the defect and was approximated first to the severed portion of the internal carotid artery and then to the severed portion of the common carotid. The bulldog clamp on the internal carotid was then released and a good retrograde flow was obtained. Small bleeding points in the anastomotic line were closed with interrupted arterial silk sutures. Then the proximal bulldog clamp on the common carotid artery was released and additional small leaks were similarly closed. The graft site was observed closely for a period of fifteen minutes and no further leakage occurred. The cervical fascia was approximated with interrupted sutures and the skin was approximated with skin clips.

Convalescence from the operation was entirely uneventful. The patient recovered normally from anesthesia and showed no residual reflex changes or abnormal neurologic signs. There was good pulsation in the carotid artery. The patient was discharged on the sixth postoperative day and has remained well for one year. A letter from the referring physician, Louis R. Farri, M.D., of Wheeling, West Virginia, stated that although at first the patient complained of a mild headache on the left, he had been completely relieved of it. There is no palpable recurrence of the tumor.

Comment. It is quite possible that since the patient had a good reflux flow of blood through the distal end of the carotid, he would have survived without arterial graft. However, in some older patients provisions for arterial grafting of this type should be made.

SUMMARY

1. A case is reported in which removal of a carotid body tumor necessitated sacrifice of the carotid artery.

2. The carotid artery was replaced with a frozen dried graft, and one year after operation the patient is well.

Laceration of Popliteal Artery Due to Blunt Trauma

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THE following case is reported because we believe that the manner in which the injury was incurred was quite unusual. Injuries to major arteries, while not too common in civilian practice, are not so rare as to deserve special mention. They are, however, almost always associated with penetrating injuries or fractures. In a search of the literature we were able to find only one mention of an injury to a popliteal artery which was due to blunt trauma [*1*]. That reported injury was caused by a blow to the popliteal area by a piece of sheet metal, and the diagnosis was established by arteriograms rather than by surgery. The report did not deal with the possible mechanical factors involved in the production of such an injury without either fracture or penetration of the soft tissue.

CASE REPORT

D. J., a fifteen year old white boy, was admitted to the Garrison Hospital, Garrison, North Dakota, on the evening of October 21, 1955, with the following history: During a high school football game, he had been tackled from behind immediately after catching a pass. He, as well as others who saw the tackle, felt that it had not been unusually rough or violent. He felt a little pain in the right knee, lay on the ground momentarily and then stood up. He took about two steps and fell again. He was supported on both sides as he hobbled from the field. Since he noticed only slight pain and swelling, he simply sat on the sideline. However, after about ten minutes he noticed marked increase in both pain and swelling, and was then seen by a doctor who was in attendance at the game. The doctor was greatly impressed with the extent of the swelling (as seen through the protective clothing) and had the boy taken immediately to the emergency room for closer examination.

Examination at the hospital showed a tremendously swollen right lower extremity with the center of the swelling in the popliteal space. The swelling extended about half way up the thigh and well into the calf. The leg was cold and blanched, and there was no suggestion of a pulse below the knee. The pain was extreme at this time and intravenous morphine was given with only slight relief. X-ray examination of the knee was negative for fracture or dislocation. There were no lacerations or other evidence of external trauma. A diagnosis of injury to the popliteal artery was made and immediate preparation for surgery carried out.

Under endotracheal anesthesia the patient was placed in the prone position and a pneumatic tourniquet placed about the upper thigh. A vertical incision was started on the medial aspect of the thigh, carried transversely across the crease of the popliteal fossa and then carried down the lateral aspect of the leg. On entering the popliteal space, clots of blood virtually exploded from the wound and gushes of blood followed. The bleeding was quickly controlled with inflation of the tourniquet. The popliteal space was carefully explored and a completely divided popliteal artery was noted. The artery had been divided transversely and in a fairly clean-cut manner. The edges were not especially ragged and they certainly did not suggest a tearing type of injury. There was no proximal or distal dilatation to suggest any previous aneurysm. The intima did not appear to be abnormal in any way. There was no apparent damage to other structures except

for the obvious discoloration of tissues from the extravasation of blood. The popliteal vein was free from injury.

Approximately 1 cm. of the proximal and distal artery was excised to obtain clean-cut ends for anastomosis. An end-to-end anastomosis was then carried out with continuous everting No. 5-0 arterial silk. A dilute solution of heparin was washed through the artery after completion of the anastomosis. Minimal oozing of the suture line stopped after about two minutes and good pulsation was noted in the distal artery. The wound was closed in layers with interrupted silk and the extremity was immobilized with a plaster splint.

Postoperatively, a dorsal pedal pulse was always palpable. The pulse was quite faint for the first twelve hours. A paravertebral block was done without noticeable effect on the strength of the pulse, but the foot was warm and the color good. By the end of twenty-four hours the pulse was quite strong, and at the end of three days it was comparable to that on the left. Sutures were removed from a well healed incision at the end of seven days. The cast was removed on the fourteenth postoperative day and passive exercises were begun. During the next two weeks the exercises were rapidly increased and the patient was walking without difficulty. A foot drop had been noted after removal of the plaster and this was treated vigorously without immediate noticeable effect. The patient had an area of anesthesia along the lateral aspect of the leg and dorsum of the foot, which was thought to be due to trauma to the common peroneal nerve. Since his discharge from the hospital this cleared slowly, and when last seen was only a very small area on the dorsum of the foot. The foot drop responded in part, but there was still some limitation in dorsiflexion of the foot. There had been definite muscle atrophy of all the muscles of the calf, and this was still quite apparent. Measurements of the calves in May, 1956, showed less disparity than when measured three months previously. The patient was lost to follow-up and has not been seen since May, 1956.

COMMENTS

It is interesting to speculate as to the mechanics of this injury. The patient felt no pain at the moment of injury, and there is nothing in the history or clinical findings to suggest temporary subluxation. There was no history of previous injury to the knee. The patient, who actively engaged in sports, was in excellent physical condition and his musculature was exceptionally well developed for his age. The force of the tackle must necessarily have been spread over a fairly large area in contrast to the localization of force that might be expected from the leading edge of a piece of sheet metal (as in the case reported by Horn and Sevitt [1]). The patient was wearing the usual knee guards and padding. Of possible significance is the fact that his knee pads were held in place by multiple rubber bands placed both above and below the knee. The patient stated that he had used about twice as many rubber bands as usual and that they had felt rather tight. It is a little tempting to suggest that these bands created a localized area of increased intra-arterial pressure which made the artery more susceptible to injury by either a direct blow, forcible extension of the leg, or both. If this hypothesis is at all reasonable, one should probably assume that the distal bands were the tighter of the two. If one accepts such reasoning, however, it then becomes difficult to explain why the venous return would not have been so seriously affected as to make running difficult.

SUMMARY

1. A case of complete division of the popliteal artery due to blunt trauma is presented.

2. Alteration of the hemodynamics of the vessel by constricting rubber bands is suggested as a possible factor in the causation of this injury.

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Ilioinguinal Swellings

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BECAUSE swelling in the groin is usually due to enlarged nodes or to hernias, we rarely give comprehensive consideration to other causes of tumefaction in this area. It was our experience recently to have this brought forcibly to our attention by being totally in error in our preoperative diagnosis in such an instance.

CASE REPORT

The patient, a sixty-two year old white man, was admitted to Highland Park General Hospital with a chief complaint of swelling and a sensation of pressure in the right groin. The pressure sensation had developed three months previously and had been present about four weeks before swelling became apparent. With the appearance of the swelling the pressure became somewhat lessened but a dull, low grade pain developed which was intensified by walking. At no time were the symptoms incapacitating. They were of sufficient magnitude, however, to cause him to consult his family physician.

Review of the patient's history revealed a knife wound of the anterior mid-thigh inflicted many years before with no ill effect. A high saphenous ligation had been performed in 1950 with an uneventful recovery. Otherwise the patient had been in good health with no history of trauma or infection.

Physical examination revealed a well nourished and well developed white male of stated age. The heart and lungs were considered normal. There were no abdominal scars, masses or tenderness. Generalized lymphatic adenopathy was not present. The disorder was limited to the right groin where a definite swelling presented itself below the mid-portion of the inguinal ligament. The mass measured 5 by 7 cm., with the greater dimension being in the long axis of the extremity. There was no suggestion of inflammation and no sign of hernia was noted upon coughing or straining; neither was there bruit nor arterial pulsation. The tumor was firm, almost hard, and did not seem cystic. The surface was generally smooth with a slight tendency toward irregularity. It appeared to lie at some depth from the surface and could not be reduced with pressure. Palpation caused no discomfort. The femoral artery was displaced medially. Motion of the right hip joint was not impaired save for slight limitation of extreme flexion. Careful scrutiny of the lower extremities, genitalia and anorectal regions revealed no infectious or neoplastic lesions. The scars of the previously mentioned knife wound and saphenous ligation were well healed and scarcely visible.

Laboratory studies were not remarkable except for a white blood count of 14,500 per cu. mm. with a normal differential. The preoperative diagnosis was lymphoma, possibly lymphosarcoma.

With the patient under general anesthesia an oblique incision 12 cm. in length was made beginning at the mid-point of the inguinal ligament and extending downward over the summit of the mass. The lymph nodes in both the superficial and deep groups appeared normal and it became apparent that the mass lay deep to the fascia, displacing the femoral vessels and nerve anteromedially and the iliopsoas muscle laterally. (Fig. 1.)

Because of the unexpected large size of the tumor, all adjacent tissues were stretched to a considerable tension which made exposure and dissection difficult. After clearing some attenuated fibers of the sartorius muscle from the surface, the lesion was seen to be well encapsulated and to have a deep bluish color highly suggestive of a cyst. By means of careful blunt dissection the mass was determined to be cystic and was found to extend deeply toward

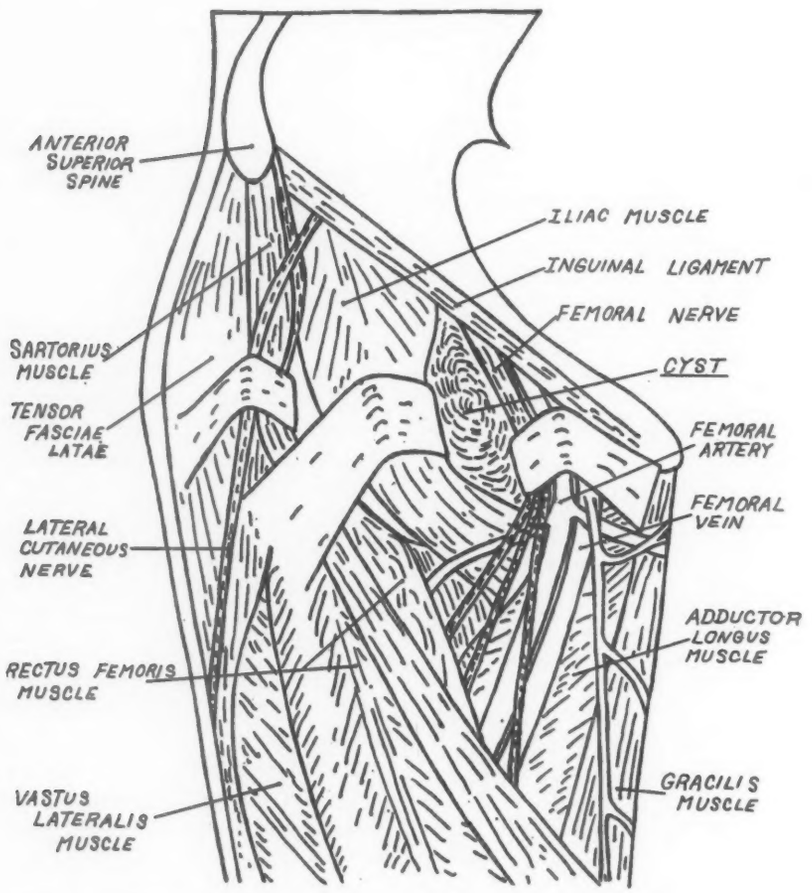

FIG. 1. Schematic diagram of right upper anterior thigh showing exposure of cyst by retraction of femoral vessels and nerve medially and muscle groups laterally.

the hip joint with the musculotendinous portion of the iliopsoas muscle being inferior and lateral. Superiorly it extended slightly into the pelvis beneath the inguinal ligament. In attempting to separate the intimate connection with the iliopsoas tendon the cyst was ruptured and the contents were seen to be synovial in character. A communication with the hip joint through the capsule anterior to the femoral neck was demonstrated. The entire cyst wall was excised and the tissues were allowed to fall together. Fascia and skin were closed with sutures. The postoperative diagnosis was bursal cyst of the iliopsoas tendon communicating with the hip joint. The pathologic diagnosis was bursal cyst.

During the postoperative period the patient experienced paresthesias in the anterior thigh and weakness of the quadriceps femoris muscle. These complications were thought to be due to the forceful retraction of the femoral vessels and nerve necessary to expose the hip joint anteriorly. Within three months all neurologic manifestations had disappeared and recovery was complete. At the time of this writing, six months after surgery, there is no evidence of recurrence.

COMMENTS

In light of the aforementioned experience, we felt that a review of the diagnostic possibilities associated with swelling in the inguinal region might not be remiss. If the pathologic condition were to be considered from the standpoint of the anatomic region involved, the following classification could be utilized:

I. Inguinal Canal. Hernia and hydrocele are the chief lesions here and no comment is needed. Abnormalities of an undescended testicle must be kept in mind.

II. Inguinal Nodes. The superficial nodes roughly parallel the inguinal ligaments and

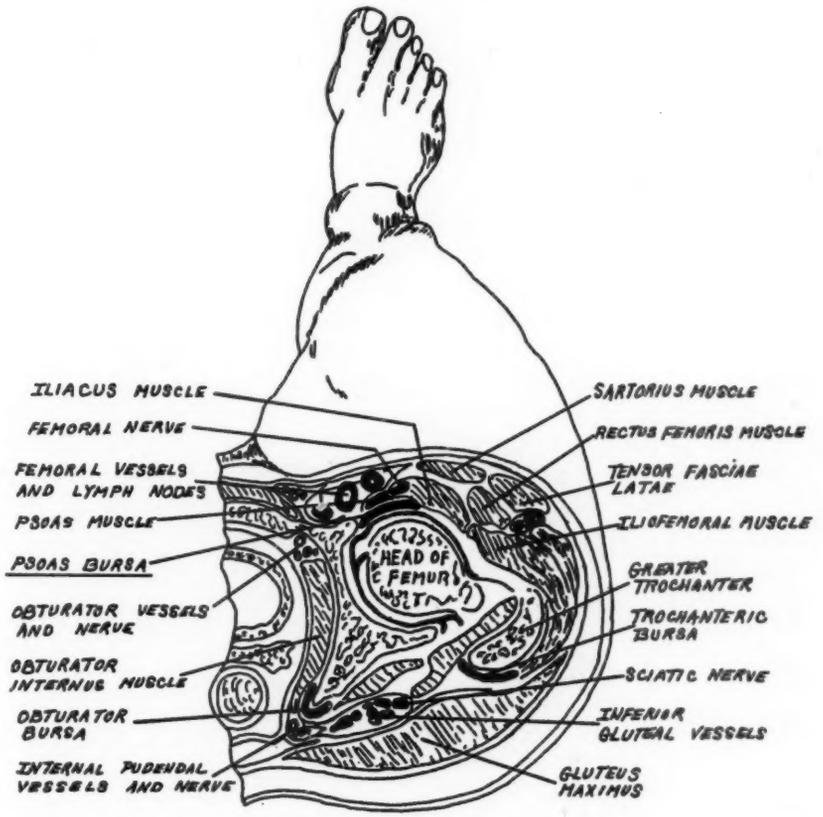

FIG. 2. Cross sectional view of right hip joint illustrating the normal anatomic relations of the psoas bursa. (Modified from THOREK, P. Anatomy in Surgery. Philadelphia, 1951. J. B. Lipppincott Co.)

overlie the cribriform fascia, while the deeper group assume the direction of the femoral vessels and lie below the deep fascia. When enlargement of these nodes occurs, both acute and chronic inflammatory conditions must be kept in mind. Inflammation of the genital and perineal regions, lower abdomen and back, buttocks and upper part of the thighs drain to the superficial lymph nodes. The deep nodes receive their afferent lymphatics from the lower thighs, legs and feet. The cardinal signs of inflammation will usually serve to classify this type of swelling.

Neoplastic enlargement of the inguinal nodes is more often metastatic than primary, although it may be part of a diffuse lymphatic involvement, such as Hodgkin's disease or lymphosarcoma. Lymphoma, either benign or malignant, can arise wherever lymphoid tissue is found. Palpation usually reveals firmness and nodularity of the lesion suggesting that it is made up of many component parts. A proper scrutiny of the regions whose lymphatics drain to this area will frequently establish the diagnosis. Biopsy is a direct and valuable approach.

III. Femoral Canal. Hernia is the most common cause of swelling in this area, usually containing omentum and often being non-reducible. The fact that the swelling occupies a position medial to the femoral vessels is a useful diagnostic point. Also, it must be remembered that femoral hernia is rarely seen before puberty and is more common in women. On occasion a femoral hernia may attain a very large size. If tenderness is present, strangulation must be suspected. Hydrocele of the femoral canal, while rare, must not be overlooked. This is usually present in conjunction with ascites.

IV. Lesions of Vascular Origin. The findings associated with arterial aneurysm, arteriovenous fistula and saphenous varix are usually so characteristic that no problem exists. However, it might be well to emphasize the importance of (1) noting the color and temperature of the extremity; (2) listening over the swelling

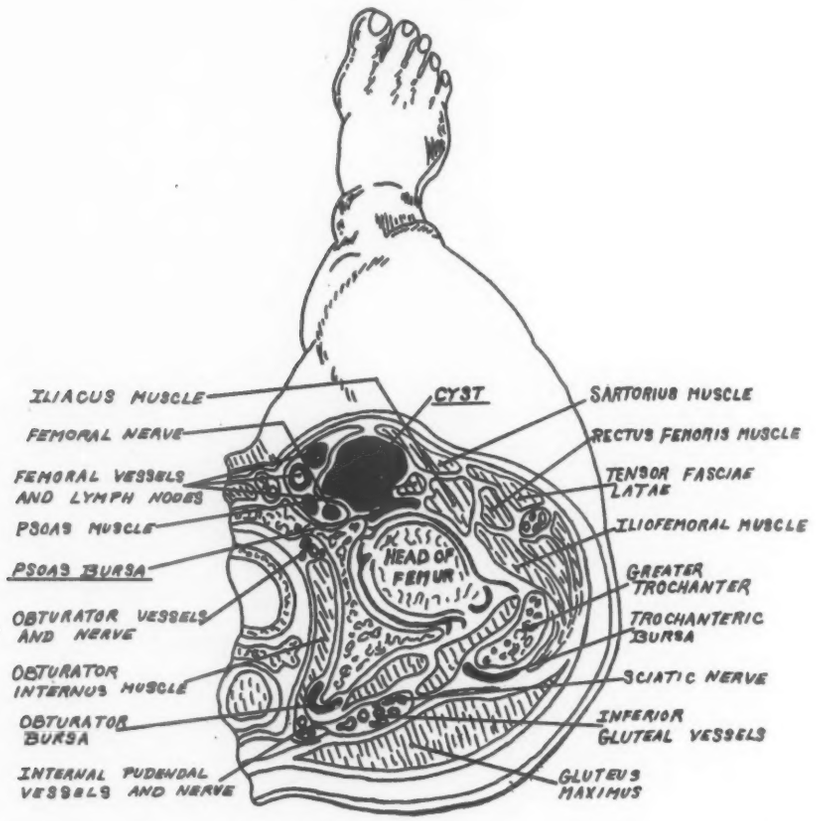

FIG. 3. Cross sectional view of right hip joint depicting location of cyst arising from psoas bursa and displacing structures lying anteriorly. (Modified from THOREK, P. Anatomy in Surgery. Philadelphia, 1951. J. B. Lippincott Co.)

with a stethescope, (3) observing the effect upon the swelling produced by elevation of the extremity, and (4) checking peripheral pulses. A saphenous varix may be differentiated from a hernia by virtue of the fact that in the erect position reduction of a varix by pressure is not maintained because of venous filling from below. One should not be misled by the presence of a cough impulse in a varix. Hematoma is a possible cause of swelling in this region but is nearly always related to trauma.

V. Tumors Arising from Nerves. Well circumscribed tumors closely related to the lateral aspect of the femoral vessels should suggest neurofibroma or similar lesions arising from nerve sheath. These sometime produce paresthesias and are often painful on palpation.

VI. Skeletal. Anterior dislocation of the head of the femur is an acute cause of swelling in the inguinal region. This is easily diagnosed by the characteristic position of abduction and outward rotation of the entire extremity.

VII. Muscle. The major muscles of this area, other than the lower edge of those of the abdomen are the sartorius, rectus femoris, iliopsoas, pectineus and the abductor longus. Rhabdomyomas and rhabdomyosarcomas are extremely rare. Psoas abscess, while uncommon in the present day, should be kept in mind; roentgen studies of the spine will confirm the diagnosis.

Certain muscles have associated bursae which could become enlarged and cystic. The chief bursa is the one which lies between the anterior portion of the capsule of the hip joint and the tendon of the iliopsoas muscle. (Fig. 2.) This bursa is said to communicate frequently with the hip joint. Cysts arising from this bursa are apparently infrequent. We were able to find only two cases described in the literature. Cook [1] in 1952 reported such a lesion in a forty-two year old white man which was intimately adherent to the femoral artery and was cured by surgical excision. Herrington and Edwards [2] also described a case in a sixty-two year old white man which was cured by surgical

excision. Both of these cases were reported as ganglion cysts which are undoubtedly idential with bursal cysts.

In the case under discussion some pathologic stimulus provoked excess formation of fluid within the iliopectineal bursa or within the hip joint which communicated with the bursa. The extreme tension within the cyst noted at operation suggested that synovial cells are capable of secreting under great pressure. Inasmuch as synovial fluid from a joint is identical with that from a bursa it was impossible to determine the origin of the fluid. As the cyst enlarged it gradually dissected its way anteriorly between the vessels and the psoas muscle. The sartorius muscle was displaced anteriorly and became thinned out over the surface of the tumor. The only visible manifestation was a swelling in the groin which did not readily suggest that the source was in or near the hip joint. (Fig. 3.)

It seems likely that the same pathologic process has occurred many times but reports have not found their way into the literature.

SUMMARY

A case illustrative of an unusual cause of swelling in the iliopsoas region has been cited. The lesion, which arose from the iliopsoas bursa, communicated with the hip joint and produced a tumor beneath the inguinal ligament. The differential diagnosis of swelling in the ilioinguinal region has been presented.

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Total Reconstruction of an Ear

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THIS is a case of a forty-seven year old precision machinist who was born with a bilateral deformity of the ears consisting of total absence of the right external ear and partial absence of the left. (Figs. 1 and 2.) He sought aid after all these years because of his occupation and the fact that he found it impractical to wear glasses for his normal age visual deterioration without ears.

The surgical procedure outlined will be restricted to the reconstruction of the total right ear in order to avoid confusion, although many of the bilateral reconstructive procedures were carried out simultaneously.

On March 6, 1951, the seventh rib cartilage from the right chest cage was removed in the usual fashion. This rib cartilage was then carved to simulate the right ear cartilage and buried in the prepared pocket in the region of the right ear. This was sutured into position with interrupted No. 5-0 silk suture and the usual pressure dressing was applied. A photograph (Fig. 3) taken on March 12, 1951, just befoer the sutures were removed, illustrates this first stage.

Within a period of two months time it was noted that the cartilage implant was completely absorbed and no sign of it could be found by palpation. There was no evidence of infection, and the cartilage was never removed. In view of this fact it was decided that a piece of shaped polyethylene plastic material would be used instead of the autogenous rib cartilage.

On June 21, 1951, an incision was made in the area of reconstruction and a subcuticular pocket was dissected. Into this pocket a crescent-shaped polyethylene plastic support was placed. This support was made from a sheet of polyethylene that had been carved by knife and smoothed down with a dental burr. This area healed uneventfully.

On November 13, 1951, the patient returned to surgery and the hair-bearing portion of the scalp skin over the buried polyethylene and

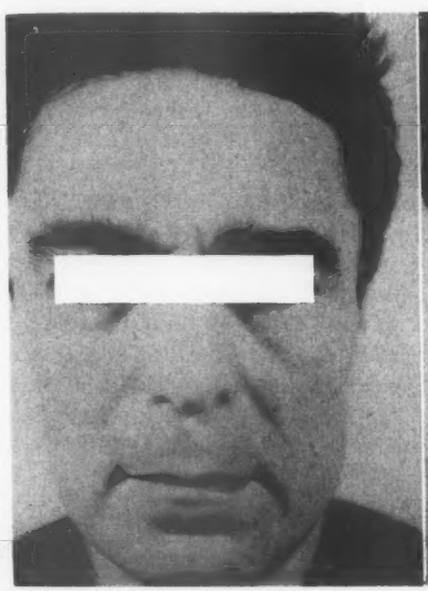
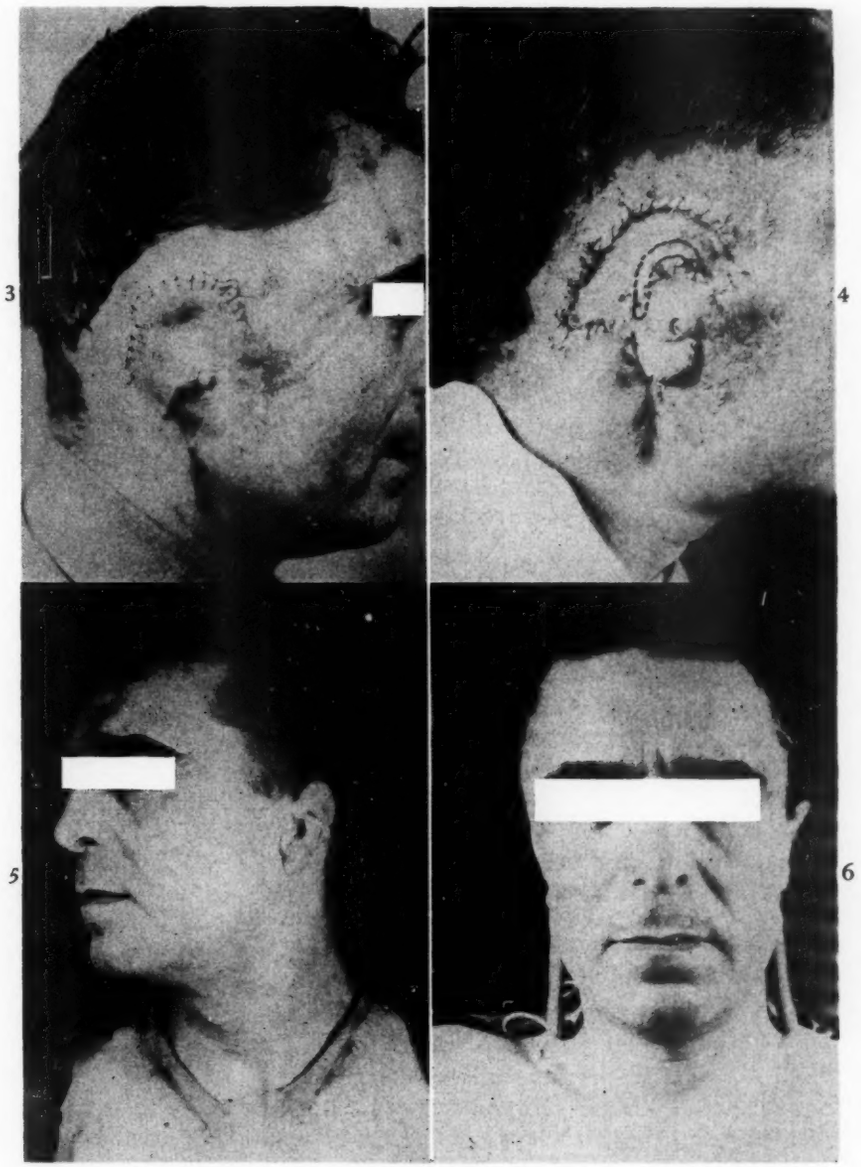


FIG. 1.

FIG. 2.



FIGS. 3 to 6.

immediate postauricular region was dissected out. A thin layer of tissue was left immediately over the polyethylene. With a Padgett dermatome, a split-thickness skin graft was taken from the upper region of the right chest for better skin color match. This graft was sutured into position to cover the defect produced in order to replace the hairy skin with non-hair–bearing skin in this location. Before this graft was sutured in place, a small piece of the posterior polyethylene implant was found protruding. This portion was removed and tissue sutured over the remaining implant with continuous No. 4-0 plain catgut in order to produce a proper bed for the skin graft. At the same operation a semi-circular incision was made in the region where the right ear lobe should be, and this was elevated as a U-shaped flap about one-fourth larger than an ordinary ear lobe to allow for shrinkage. Another part of the split-thickness skin graft which was taken from the right chest was sutured into position to back this flap and complete reconstruction of the ear lobe. The skin graft was also used to cover the defect produced on the neck by elevation of the flap. The pressure dressing was sutured into position. A photograph (Fig. 4) taken at the office eight days postoperatively shows the

FIG. 7.

FIG. 8.

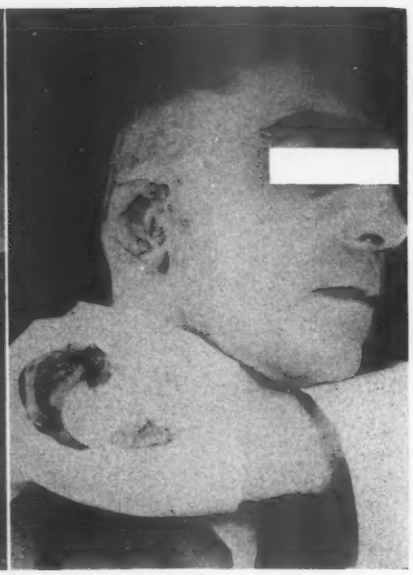


FIG. 9.

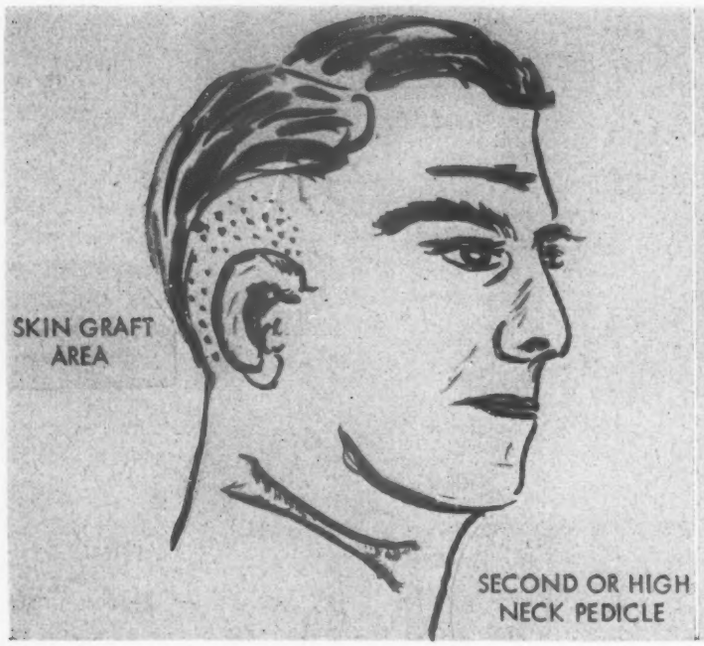


FIG. 10.

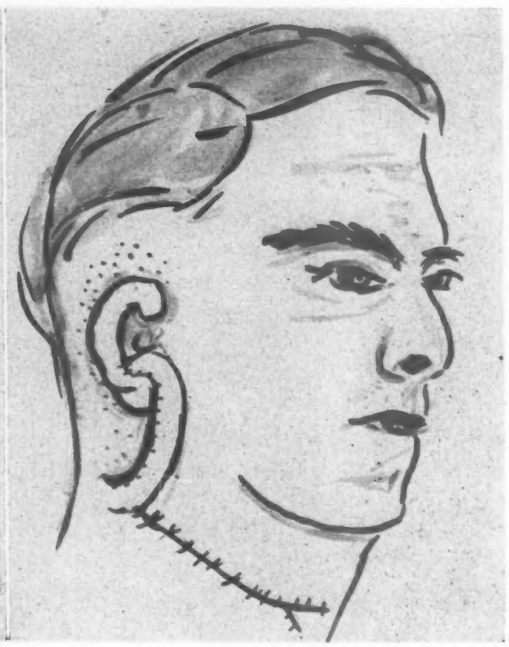


FIG. 11.

skin graft and reconstructed ear lobe in position.

On January 7, 1952, bilateral supraclavicular neck tubes were elevated for later use as the helix of each ear. A photograph (Fig. 5) taken ten days postoperatively shows these healed bilateral neck tubes in position. The medial end of the right neck pedicle was string-constricted ten minutes the first day, twenty minutes the second day, forty minutes the third day, sixty minutes the fourth day and two hours the fifth day immediately preceding the next surgical procedure.

On February 8, 1952, the medial end of the tube pedicle was detached and the pedicle brought up into position just above the reconstructed ear lobe of the right ear.

A photograph (Fig. 6) taken on February 27, 1952, illustrates the string tying of the lower end of the pedicle in preparation for advancement of the pedicle toward the ear.

On February 29, 1952, the lower end of the

FIG. 12.

FIG. 13.

pedicle was advanced and sutured to the proposed upper helix area.

On May 7, 1952, the tube pedicle healed in position on the right ear area. (Fig. 7.) On that same date in the office, with the patient under local anesthesia, an incision was made in the reconstructed part of the right ear corresponding to the position of the anterior helix. Anterior to this incision the deep fat was dissected out toward the ear canal in order to reconstruct what might appear to be a concha and to help enlarge the external auditory meatus. Another triangle of fat was dissected out between where the anterior crus and the posterior crus of the antihelix should be. Closure of these incisions was done with interrupted No. 5-0 plastic suture and a pressure dressing applied to the entire area.

A photograph (Fig. 8) taken on May 24, 1952, shows the results of this surgical procedure.

On June 6, 1952, the patient returned to the hospital and the previously reconstructed right ear was elevated off the postauricular region. The tube pedicle in its posterior portion was elevated and grooved in its undersurface. The implanted polyethylene was slipped into this groove to give support to the reconstructed ear. A continuous No. 5-0 chromic catgut suture was used to attach the posterior grooved tube pedicle to the center of the encapsulated fibrous polyethylene crescent. A split-thickness skin graft was taken from the left chest and used to cover the defect produced in the reconstructed right postauricular region. This was sutured into position with interrupted and continuous No. 5-0 plastic suture and held thereto with Kerr dental modeling compound. A small nasal speculum was used in the rudimentary right external ear canal for stretching and exposure in order to open the canal farther. A curved incision was made down the canal while stretching it open. A modeling compound mold was placed in the canal covered by a split-thickness skin graft to cover all raw surfaces produced. A turban type pressure dressing was applied to the entire area.

A photograph (Fig. 9) taken eight days postoperatively shows the patient at the time of the initial dressing after this procedure. The modeling compound mold used in the postauricular area and also the mold used within the ear canal are demonstrated.

On August 31, 1953, with the patient under local anesthesia, an incision was made inside the reconstructed portion of the helix of the right ear and a piece of dissected polyethylene was inserted in the pocket of the helix in an attempt to give better support to the helix on

FIG. 14. FIG. 15. FIG. 16.

the right side. Closure of this incision was made with interrupted No. 4-0 dermalon suture.

On November 16, 1953, it was decided that the ear had shrunk to the point that it was too small and additional tissue should be added. With the patient under local anesthesia a pedicle was elevated in the right upper neck region. Unfortunately, no photograph is available of this procedure and a diagram (Fig. 10) is substituted to illustrate the pedicle that was elevated.

On January 15, 1954, the lower end of this pedicle was detached and attached to the posterior right ear area. This was sutured into position with interrupted No. 4-0 dermalon. (Fig. 11.)

In March, 1954, the remaining neck attachment of this pedicle was detached and brought to a new attachment just below the anterior upper attachment of the first pedicle. A photograph (Fig. 12) taken on August 7, 1954, illustrates the one pedicle inside of the other.

On August 30, 1954, the upper end of the inner pedicle was detached about ½ inch below its upper attachment. The upper portion of this pedicle was freed toward its attachment area and moved anteriorly to an incision made in the anterior portion of the helix. The lower portion of the pedicle was freed toward the lower attachment and sutured to the lower portion of the outer pedicle which was advanced cephalad and anteriorly. This enlarged the ear. All incisions were sutured with interrupted No. 4-0 dermalon suture. (Fig. 13.)

This completed the surgery on the right ear. Final photographs (Figs. 14 to 16) were taken on December 4, 1954, to illustrate the final appearance of the patient with and without glasses which he now is able to wear.

CONCLUSION

This was a case of necessity in reconstruction of ears so that the patient could wear his glasses without the use of adhesive tape and would have a better cosmetic appearance.

The case illustrates not only the multiple steps necessary for the total reconstruction of an ear but also the fact that a better looking ear can be reconstructed if tube pedicles are used (one from the lower neck and one from the upper neck) in order to supply enough tissue following sufficient time for shrinkage.

The case also illustrates the fact that polyethylene plastic material may have to be used at times, in spite of the fact that I never like to use foreign material for support, as this patient absorbed his own cartilage.

The photographic record of this case illustrates the transition from atresia to total reconstruction of an ear.

With the aid of glasses the patient is able to continue his work as a precision machinist and is also extremely pleased with the cosmetic result.

Spontaneous Rupture of the Esophagus

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RUPTURE of the esophagus without trauma from instrumentation, violence or foreign body and in the absence of congenital anomalies, inflammation, neoplasm and diverticulum may occur. Although not a newly recognized entity (Boerhaave reported the first case in 1724), it was rarely considered ante mortem until recently. Since Barrett [1] reported the first case successfully treated by operation in 1946, the number of recorded cases has risen steadily. A rough estimate of the incidence may be obtained from the paper by Derbes and Mitchell [2] which records 157 collected cases with fifty-five being operated upon and thirty-five survivals. With increasing awareness of this condition the mortality can be lowered still further and it is with this in mind that the following case is reported.

CASE REPORT

H. R., a fifty year old white man, was admitted to the Southampton Hospital on August 1, 1955, at 9:30 P.M. Two hours earlier, while eating steak and imbibing freely of alcohol, a large bolus of meat became lodged in his lower esophagus. An episode of violent coughing followed during which abrupt hematemesis of a "cupful" of bright red blood occurred. This was followed shortly by steady pain substernum and in the left lower chest, severe enough to cause him to collapse to the floor. He was seen by his doctor who administered ¼ gr. morphine sulphate and sent him to the hospital with a presumptive diagnosis of coronary occlusion. Some time after midnight he attempted to drink some water but this was followed almost immediately by severe pain in the left lower chest. I saw the patient approximately six and a half hours after the onset of his symptoms, at which time he appeared acutely ill with a grayish pallor and anxious facies. He complained of pain in the left lower chest, made worse by inspiration. He had no pain referred to the shoulders. His temperature was 100°F. rectally, blood pressure was 130/70, and his pulse was rapid but of good quality. No subcutaneous emphysema was present. Auscultation of the chest revealed dullness and decreased breath sounds over the left base. The heart was not enlarged and showed a regular sinus rhythm. An electrocardiogram was negative for recent infarction. Urinalysis was negative. Red blood count was 5.7 million per cu. mm. with a hemoglobin of 102 mg. per cent. White blood count was 26,900 per cu. mm. with 84 per cent polymorphonuclear leukocytes. Chest x-ray revealed obliteration of the left costophrenic sinus and questionable fluid. A presumptive diagnosis of spontaneous rupture of the esophagus was made, and a chest consultant was called (Dr. James Finnerty) who concurred with the diagnosis. Approximately twelve hours after the onset of symptoms the patient was prepared for operation.

The left thorax was entered through the bed of the eighth rib and cloudy fluid immediately presented. This was aspirated, after which the lower esophagus was inspected. A grayish, fibrinous exudate was scattered over the mediastinal pleura and marked edema of the tissues was noted. A long (3 cm.) linear rent was found on the anterolateral aspect of the esophagus approximately 1 to 2 cm. above the diaphragm. A Levin tube passed orally was guided past the rupture into the stomach, after which the defect was closed with chromic catgut. The pleural cavity was irrigated with 1 million units of penicillin and then closed. An intercostal drainage tube was inserted and connected to underwater drainage. His postoperative course was singularly benign except for the rise in non-protein nitrogen which re-

turned to normal in a few days. The intercostal tube was removed in forty-eight hours and he was discharged asymptomatic after nine days.

COMMENTS

Spontaneous rupture is more apt to occur in the male, the ratio being 5:1. Cases have been reported of persons from two years [14] to seventy five years of age [15]. Significant in the histories of most patients is the presence of heavy drinking and/or eating, hematemesis, severe subxiphoid pain and violent retching.

The vomiting reflex is a complex one but essentially there is a sudden contraction of the stomach with rise in intragastric pressure against the resistance of the normal esophagogastric "pinchcock" which relaxes, allowing a sudden retrograde surge of fluid and air into the lower esophagus. The consensus of present opinion favors a hydrodynamic force as the responsible factor in spontaneous rupture of the esophagus. In 1884 it was shown by MacKenzie [3], using isolated cadaver esophagi, that tying the distal end and introducing water proximally under pressure consistently produced tears just proximal to the cardia. Duval [5] and Burt [5] independently concluded that the rupture was due to the rapidity of increase in intraluminal pressure rather than the amount. Mackler [4] utilized sixty-five fresh cadavers and repeated MacKenzie's experiments. He found that rupture always occurred just proximal to the cardia and on the left anterolateral aspect. He felt also that the rupture was caused by sudden increase in intraesophageal pressure transmitted from the stomach. Bodi et al. [7], approaching the problem from another angle, inserted a tube into the stomach in fresh cadavers, leaving the esophagus *in situ* and undisturbed as far as possible. Controlled oxygen pressure was exerted against a barium suspension through the tube and at the same time the cardia was manually constricted. When this constriction was suddenly released rupture repeatedly occurred just above the diaphragm on the left side of the esophagus and in a linear direction. Less pressure was required to cause bursting if obstruction was produced by closing the mouth. It is of interest that in practically all the reported clinical and experimental cases the rupture was in the longitudinal direction. Quigley and Brody [6], using mathematical equations, showed that less force is required to produce a longitudinal tear than a rupture in the circular direction. Derbes and Mitchell [8] support this concept with elaborate calculations.

Despite the evidence favoring a hydrostatic mechanism as the causative factor in rupture it is suggested that anatomic factors may play a contributing role. The muscle fibers of the lower end of the esophagus tend to be thinned out [9] and "the thickness of the inner layer is believed to be less than elsewhere" [7]. The angulation of the lower end of the esophagus, as it passes from the thoracic cavity into the abdomen, may contribute to a partial obstruction with consequent increase in intraluminal pressure.

The existence of a sphincter mechanism inherent in the wall of the lower esophagus has been debated since Helvetius [13] first described a morphologic sphincter in 1719. Lendrum [12], after dissecting more than 100 esophagi, denies the existence of a sphincter which Lerche [11] after similar dissections states has an anatomic basis. Regardless of whether or not an anatomic sphincter exists, a physiologic one has been demonstrated [10]. Roentgenologically it can be demonstrated only with a full esophagus and when contracted it is seen as a narrowing, 1 to 3 cm. above the right crus of the diaphragm. It is in this area that most if not all ruptures occur.

Conditions other than vomiting that may increase the intraesophageal pressure with rupture have been reported, i.e., defecation [16] and epilepsy [17].

In addition to a suggestive history (violent retching occurring after heavy food and/or alcohol intake followed by severe substernal pain and perhaps hematemesis), the finding of subcutaneous emphysema of the upper chest and neck should indicate the diagnosis. Unfortunately emphysema is not an early sign and the patient's condition may preclude an adequate history. Laboratory aids such as a chest x-ray may frequently reveal blunting of the left costophrenic sinus. A thin radiopaque media introduced into the esophagus under fluoroscopic control may reveal the perforation. Thoracentesis with analysis of any obtained fluid for acid content may be performed.

In conclusion it may be said that the diagnosis will only be made if it is first suspected.

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Perforation of Meckel's Diverticulum by Foreign Body

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MECKEL'S diverticulum is the remnant of the embryonic vitelline or omphalomesenteric duct. It is found in about 2 per cent of routine autopsies. According to Portis [8], the diverticulum is described as follows: "In 1.8% of males and 0.8% of females, the embryonic vitelline duct connecting the yolk sac to the midgut does not atrophy, but remains open at its intestinal end to form the cul-de-sac known as Meckel's diverticulum. Of variable length, this diverticulum usually arises from the antimesenteric side of the ileum at a distance from 25 to 100 cm. above the ileocecal valve. Its lumen is lined with ileal mucosa, but heterotopic tissue such as pancreatic rests and gastric, colonic and duodenal mucosa may also be present."

Complications from this structure are quite rare and the majority remain symptomless, being found only at the time of laparotomy or autopsy. In 1949 Caylor [1], in his article on Meckel's diverticulum, discussed many of the pathologic changes which can occur. Some of the complications are: (1) inflammation, (2) intestinal obstruction and intussusception, (3) hemorrhage such as that seen with ulceration of heterotopic gastric tissue or from erosion of a vessel by foreign body [10], (4) site of benign and malignant lesions, and (5) perforation due to erosion or ulceration of heterotopic tissue or foreign body. It is the last type of complication with which we are primarily interested in this article.

The perforation of Meckel's diverticulum secondary to inflammation or ulceration does occur at times. However, the perforation of Meckel's diverticulum secondary to a foreign body is exceedingly rare. Because of the anatomic structure of a Meckel diverticulum there is no doubt that foreign bodies frequently enter a diverticulum and leave as readily without causing any trouble. There are those few cases, however, in which a foreign body remains, imbeds itself in the wall and may eventually perforate. The authors would like to cite one case in which Meckel's diverticulum with foreign body was found incidentally at the time of laparotomy.

A sixty-seven year old psychotic white male was transferred from the neuropsychiatric to the surgical service (W. R. G., Jr.) at the Veterans Administration Hospital, Dayton, Ohio, on March 14, 1955. There was a history of abdominal pain since the evening of March 12, 1955. The patient had pica as one of his psychotic manifestations and had been known to eat many things such as hair and wood in the past. Because of pain being most pronounced in the right lower quadrant of the abdomen, a preoperative diagnosis of acute appendicitis with possible perforation was considered first. At the time of surgery, two perforations of the ileum were found along with presence of foreign bodies in the intestinal tract. The perforations were closed primarily. Distally, a Meckel diverticulum was also found to be present containing a foreign body. Grossly, the diverticulum was approximately 1 inch in diameter at its base and 1½ inches in length. At the tip there was a small, firm, irregular object within the lumen which could not be expressed back into the ileum. In view of the palpable foreign body being present and the potential danger of inflammation, perforation or both developing, the Meckel diverticulum was removed. This was opened after surgery and found to contain an irregular thick piece of bone measuring approximately 1 by 0.8 cm. and a small fragment of wood. The patient's postoperative course was uneventful.

Pathologic examination of the Meckel diverticulum revealed early inflammatory reaction in the wall. It is possible that these foreign bodies might have eventually caused acute inflammation with or without perforation of the diverticulum if multiple perforations of the ileum had not occurred first. It is also possible that these foreign bodies might have passed back into the ileum and remained asymptomatic.

The presence of foreign bodies without leading to perforation does occur and has also been discussed by MacFarlane [6], who referred to Miller's case of 1927. It is our purpose in this article to present another case of foreign body perforation.

CASE REPORT

A thirty-five year old white woman was admitted to the surgical service of one of the authors (P. E. Z.) at the Tioga County General Hospital on April 24, 1956, with the chief complaint of abdominal pain. Two weeks prior to admission the patient had arisen in the morning with pain in the pit of her stomach; this pain migrated down to the right side of her abdomen three or four hours later. Six days before admission to the hospital, the pain was still present low down in the right side of her abdomen and she could not stand up because of it. The pain was sharp and intermittent, with no associated nausea or vomiting. The remainder of the systemic review was normal.

On examination the patient was a well developed, well nourished, white woman who appeared moderately ill. Positive findings revealed fairly marked tenderness in the right lower abdominal quadrant, but no mass or rebound tenderness. On pelvic examination there was moderately severe tenderness in both adnexal regions on motion of the cervix and uterus. The white blood cell count was 10,150 per cu. mm., lymphocytes 35 per cent, segmented forms 65 per cent, red blood cell count 4,500,000 per cu. mm., and hemoglobin 13.7 gm. per cent.

The patient was observed for approximately six days, during which time persistence of her pain was most pronounced in the right lower quadrant of the abdomen. On April 30th she was taken to surgery with a preoperative diagnosis of subacute appendicitis. At surgery a large Meckel diverticulum was found approximately 2½ feet from the ileocecal valve. There was a moderate inflammatory reaction of the end of the diverticulum, with a fish bone sticking out through the wall. The pathology department reported the diverticulum as being covered with a fibrinopurulent exudate. At the site where the foreign body (fish bone) had perforated the wall there was a foreign body reaction and acute inflammation. The appendix, also removed at surgery, revealed a low grade inflammatory reaction in the serosa and the mucous membrane (subacute appendicitis). The postoperative course was uneventful and the patient was discharged from the hospital on the eighth postoperative day. A history was obtained after surgery, of the patient last eating fish about six months prior to onset of the present illness.

REMARKS

In 1939 Persson [7] reviewed the literature on this subject and found twelve cases. He also reported three more of his own, making a total of fifteen cases. In 1943 Rossman [9] reviewed the literature again and found nineteen cases. He reported a case of his own, making a total of twenty cases. His was the fifteenth case of perforation caused by fish bone. He found only five cases of perforation due to foreign bodies other than fish bone. These were two caused by wooden splinters, two by part of a sewing needle and one by a Gramophone needle.

In 1948 MacFarlane [6] found twenty-two cases and added a case of his own, to make the total twenty-three. He found fifteen cases of perforation due to fish bone, three due to a spike of wood, two due to parts of a sewing needle, one caused by a Gramophone needle and one caused by a piece of rolled tomato skin (Hiller and Bernhard's case, 1933 [4]). MacFarlane's own case was due to a cabbage stalk, the first of its kind reported. As we can see by the statistics, fish bone perforation is by far the most common type of foreign body perforation and comprises 65 per cent of the total. In 1950 Ward-McQuaid [12] reported a list of the complications of Meckel's diverticulum found at operation over a ten-year period. He found one case of foreign body perforation in this study and added it to MacFarlane's [6] total of twenty-three cases, making a total of twenty-four cases. Ward-McQuaid [12] reported a case of foreign body perforation by tomato skin, which as far as we could determine makes the second case of this type recorded in the literature.

In 1951 Whelan [15] reported another case of

foreign body perforation due to fish bone. This was the last and most recent case that we could find. To date, on reviewing the literature we have found a total of twenty-five cases. Our case makes the total twenty-six: seventeen cases caused by fish bone, three by a spike of wood, two by parts of a sewing needle, one by a Gramophone needle, two by a piece of rolled tomato skin and one by a cabbage stalk. MacFarlane [*6*], as well as other authors, found that foreign body perforations were more common in the male than the female. Our patient was the first female since MacFarlane's case. Almost all cases except for Weinstein's case [*14*] were diagnosed preoperatively as acute appendicitis.

In those cases in which there is a long history of repeated episodes of abdominal discomfort similar to appendicitis, one should consider the possibility of Meckel's diverticulum. The symptoms of foreign body perforation are those of appendicitis. The presence of a foreign body on x-ray film of the abdomen, a history of melena or history from the parents of a disturbed casting off and healing of the umbilicus [*7*] during the first few months of life may all lead one to suspect Meckel's diverticulum. However, in the majority of cases these findings are not present and would be of little help in diagnosing foreign body perforation of Meckel's diverticulum preoperatively. The diagnosis is made at the time of surgery.

Surgical Consideration. Treatment of Meckel's diverticulum with or without pathologic involvement consists of removal when found at surgery. This may be accomplished by several methods, that is, ligation, excision or small bowel segmental resection. The choice of procedure depends on the type or size of Meckel's diverticulum and the complications present.

SUMMARY

1. Another case of foreign body (fish bone) perforation of Meckel's diverticulum has been reported.

2. The literature on this subject has again been reviewed and our case was found to be the twenty-sixth reported case of foreign body perforation of Meckel's diverticulum, and the seventeenth case due to a fish bone.

3. Diagnosis and treatment are discussed.

4. Foreign body perforation of Meckel's diverticulum is a rare disease in comparison to the one which it most frequently simulates, that is, appendicitis. A careful search for Meckel's diverticulum should always be made at the time of surgery if gross pathologic findings are not evident in the appendix.

ADDENDUM

Since this article was submitted for publication, two additional cases of foreign body perforation of a Meckel diverticulum have been found reported in the literature [*17,18*].

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True Diverticulum of the Prepyloric Area of the Stomach

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TRUE gastric diverticula containing all four layers of the stomach are relatively uncommon, some 450 such cases having been reported. Of this group, approximately seventy have been found in the distal one-third of the stomach [1–3]. In view of the difference in etiology, uncertainty of diagnosis and the frequency of the complications of diverticula in the distal one-third of the stomach, we believe that these lesions constitute an entity distinct from those near the cardia and that they should be treated with surgical excision. The following case illustrates these problems.

CASE REPORT

O. D. W., a forty-four year old Negro man with a mild psychosis, was referred to the hospital on February 5, 1954, with a diagnosis of carcinoma of the stomach. He gave a five- to six-day history of anorexia, nausea, vomiting, hematemesis, hiccough and vague upper abdominal pain. The only positive findings were a large ulcer on the lesser curvature of the stomach in the pyloric region on x-ray studies of the gastrointestinal tract and a guaiac-positive stool. When he failed to respond to an ulcer regimen, it was recommended that the lesion be removed, but the patient refused and signed out of the hospital. One year following his discharge he returned to the hospital with the complaint that his symptoms had persisted but that he had gained 20 pounds during this period of time. Re-examination revealed a normal blood picture, free hydrochloric acid in the stomach and persistence of the large ulcer of the lesser curvature of the stomach. On March 28, 1955, a hemigastrectomy and vagotomy were performed and a 4 cm. diverticulum of the lesser curvature of the antrum of the stomach was removed. (Fig. 1.)

The patient made an uneventful recovery and has been seen on June 13 and December 13, 1955, for follow-up studies, at which times he persisted in his complaints of nausea, vomiting, palpitation, numbness and sweating. No organic disease has been demonstrated on any of these examinations.

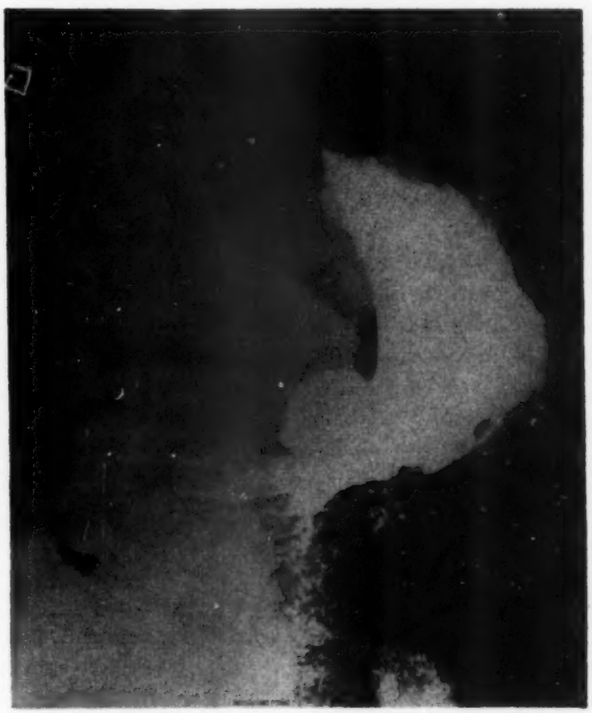

FIG. 1. Prepyloric diverticulum. Note similarity to large ulcer crater.

The pathologic report described a pouch 3.2 cm. from the pyloric ring on the lesser curvature of the stomach which measured 5 cm. long by 4.8 cm. wide on its external diameters

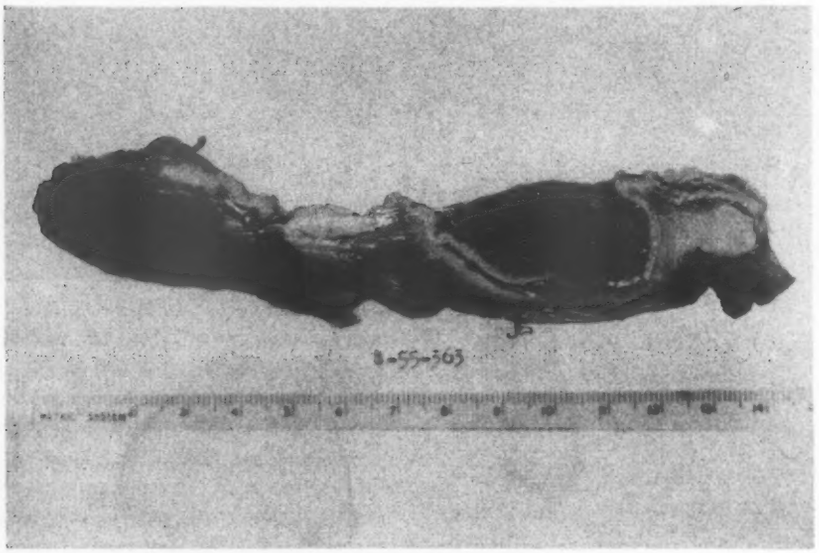

FIG. 2. Cut section of prepyloric diverticulum.

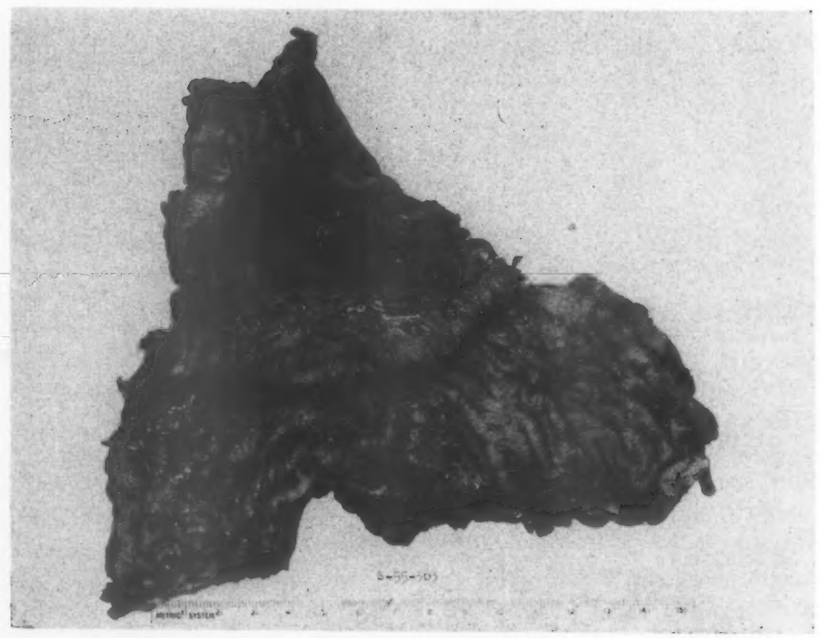

FIG. 3. Gross specimen revealing large diverticulum stoma in prepyloric area.

with a circular orifice 3.2 cm. in diameter and a 2 cm. deep gastric cavity. (Figs. 2 and 3.)

In microscopic study, multiple sections of the diverticulum revealed a normal architectural pattern. All components were well represented. The mucosa was glandular and its pattern consistent with gastric mucosa as seen in the distal portion of the stomach. There was some hypertrophy of the muscularis mucosa. There were a few small collections of lymphocytes in and about this layer. The submucosa contained increased amounts of fibrous tissue, was well vascularized, and there were occasional perivascular collections of lymphocytes. The muscular coat was well formed and hypertrophied in some places. There was also a fine degree of interstitial fibrosis of the muscular coat. The serosa was covered with adipose tissue and showed some increased vascularity.

A section from the adjacent stomach taken at the greater curvature revealed a normal architectural structure. The glandular com-

ponents appeared to be increased in number and the entire layer with the lamina propria was thickened. There was also some thickening of the muscularis mucosa which was quite marked in some places. There was increased connective tissue in the submucosa with increased vascularity, and occasional arteries showed obliterative changes. The muscular coat was hypertrophied. There were some focal collections of lymphocytes in the lamina propria, submucosa and, to a lesser degree, in the interstitial spaces of the muscular coat.

The stomach was fixed in 10 per cent formalin and stained with hematoxylin and eosin, and Masson's trichrome.

The diagnoses were (1) diverticulum of the stomach; (2) hypertrophic gastritis.

No evidence of ulcer, pancreatic tissue or tumor was seen.

COMMENTS

Etiology. It is generally accepted that the etiology of diverticula of the cardia of the stomach is a pulsion phenomenon consisting of weakness of the gastric wall with the associated pressure of food as it enters the stomach. The diverticula of the distal one-third of the stomach are believed to be a more truly congenital phenomenon which are usually associated with aberrant pancreatic tissue. This aberrant embryonal pancreatic tissue has occasionally been mistaken for carcinoma of the stomach in a diverticulum.

Symptomatology. There are no characteristic symptoms of a diverticulum of the stomach. Some patients may have no symptoms at all, while others have extremely vague to very characteristic symptoms of ulceration of the gastrointestinal tract.

Diagnosis. The preoperative diagnosis of gastric diverticulum can occasionally be made by gastroscopic examination but is usually made only by radiologic study. The criteria for such a radiologic diagnosis have been well defined by Fawcitt [4].

Complications. The complications of diverticula of the stomach are similar to those of gastric and duodenal ulcer, consisting of hemorrhage, obstruction and perforation. The reports of perforation have usually occurred in children and at least one of these was associated with obstruction. A very unusual finding has been that of a large gastric diverticulum presenting in a left inguinal hernial sac reported by Hartley [5].

In Frank's [6] review of the German literature he reports myomas, occasionally with sarcomatous degeneration, to be associated with diverticula of the distal one-third of the stomach. Mayo [7] has reported a carcinoma occurring in a diverticulum in the prepyloric area.

Treatment. Tracey and Colcock [8] have listed the following as their indications for surgery of all types of diverticula of the stomach: (1) intractability to medical treatment, (2) two or more hemorrhages, (3) obstruction associated with diverticulum, and (4) for diagnosis. We are in accord with Tracey and others who believe that surgical excision is the preferred treatment for the prepyloric lesion.

SUMMARY

1. True diverticula of the stomach are relatively uncommon, some 450 being reported to date. True diverticula of the distal one-third of the stomach, representing a distinct entity, number approximately seventy cases and represent 15 per cent of all gastric diverticula presented in the literature.

2. Because of the complications and difficulty of diagnosis of prepyloric diverticula of the stomach, it is believed that these lesions should be treated with surgical excision, both for diagnosis and treatment. It is believed that the potential danger of carcinoma of the stomach as well as the possibility of severe hemorrhage, obstruction or perforation is sufficient reason to warrant exploration of lesions in this region of the stomach.

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Torsion of an Intra-abdominal Testicle

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THE presence of an abdominal testis is in itself not unusual. Campbell [6] estimates that in about one-fifth of all cases of cryptorchidism the testis is retained within the abdomen. A testis so situated may be entirely symptom-free or it may be recognized clinically on rare occasions when it becomes occupied by a new growth and/or undergoes spontaneous torsion. The presence of a tumor in an intra-abdominal testis is a rare phenomenon. Bulkley [4] estimated that a malignancy in an intra-abdominal testis occurs not more often than once in 60,000 male admissions to a general hospital. Torsion of such a testis is less frequent, and torsion of an abdominal testis without associated malignancy is even more unusual. By 1951 Charendoff, Ballon and Simon [7] could find only nineteen authenticated cases of torsion of an intra-abdominal testis. These authors reviewed and cited the cases in the literature and were able to add a case of their own. Their case concerned a thirty-eight year old white man who had torsion and rupture of an abdominal testicle which was found to contain a seminoma.

A comprehensive review of the world literature has yielded two additional cases of torsion of an abdominal testis reported prior to 1951, and one case reported in 1952, bringing the total to twenty-three cases. Lecene in 1913 reported the case of a forty year old white man who had an intraperitoneal hemorrhage due to a bleeding fissure of a seminoma in an intra-abdominal testicle with torsion of the cord [8]. Guibal and Goepfert [10] described an almost identical case in 1946. Their report concerned a forty-two year old white man who also had a hemoperitoneum due to torsion and rupture of an abdominal testicle with seminomatous change. In 1952 Kelly and Urich [12] discussed the case of a three year old white boy who was operated upon for probable acute appendicitis but was found to have an infarcted intra-abdominal testicle.

It is interesting to review the twenty-three cases thus far reported. (Table 1.) There were fifteen patients, or about 65 per cent of all cases, in which torsion occurred with an intra-abdominal testicle containing a malignancy. Key's case was particularly interesting in that there was bilateral torsion and bilateral malignancy [11]. Charendoff and co-workers [7] stated that malignancy appeared at an average earlier age in scrotal than with abdominal testes, namely, thirty-one years compared to thirty-four years of age. When, however, the cases of Lecene and Guibal and Goepfert: are included, it is found that when malignancy occurs in either group, it manifests itself at an average of thirty-one years of age. Admittedly, some of the data are not included in the earlier reports, so a critical and accurate analysis is not possible. From the available information it would seem that no particular tumor type is favored by the ectopic site of the testicle. There were eight patients or about 35 per cent of the cases in which torsion of the abdominal testicle occurred without an associated malignancy. Unfortunately, the ages of only five of these patients are known. If one can accept these 5 patients as being representative of the group, then the average age of patients having torsion of a non-malignant abdominal testicle is 21.5 years of age.

Whether or not a malignancy is present, torsion of the abdominal testicle appears to occur more often on the right side than on the left, and the torsion may be responsible for clinical signs and symptoms simulating acute appendicitis. The manifestations of torsion have been reported to consist of nausea, vomiting and periumbilical or lower quadrant abdominal pain. If the lesion is on the right side, there may be pain and point tenderness in the right

TABLE I

DATA ON THE TWENTY-THREE PREVIOUSLY REPORTED CASES OF TORSION OF AN INTRA-ABDOMINAL TESTICLE*

Case No.	Author	Year	Age (yr.)	Side	Duration of Symptoms	Ectopia of Testis	Associated Malignancy	Pathologic Diagnosis
1.	Gerster [1]	1897	21	Right	3 days	Bilateral	Yes	Sarcoma
2.	Stiles [1]	1905	39	Right	3 days	Unilateral	Yes	Sarcoma
3.	Lecente [1]	1907	28	Right	10 days	Unilateral	Yes	Sarcoma
4.	Howard [1]	1907	15	Right	2 days	Bilateral	No	.....
5.	Lecene [8]	1913	40	Right	Hours	Unilateral	Yes	Seminoma
6.	Key [11]	1914	25	Bilat-eral	2 days	Bilateral	Yes	Sarcoma
7.	Cupler [1]	1915	?	Right	?	Unilateral	No	.....
8.	Ormond [1]	1927	42	Right	2 days	Unilateral	No	.....
9.	Pearlman [1]	1927	18	Left	10 days	Unilateral	Yes	Not given
10.	Wallenstein [1]	1927	33	Left	1 day	Bilateral	No	.....
11.	Birukov [11]	1928	14	Left	Weeks	Unilateral	No	.....
12.	Johnson [11]	1933	27	Right	2 days	Unilateral	Yes	Carcinoma
13.	Power [1]	1933	?	Left	?	Unilateral	No	.....
14.	Chitty [1]	1933	?	?	?	Unilateral	Yes	Not given
15.	Vastola [14]	1933	?	?	?	Bilateral	Yes	Embryonal
16.	Beller [1]	1935	?	Left	?	Unilateral	No	.....
17.	Jossa [11]	1936	23	Left	3 wk.	Unilateral	Yes	Sarcoma
18.	Burke [5]	1938	?	?	?	Unilateral	Yes	Seminoma
19.	Whittington [13]	1943	31	Right	?	Unilateral	Yes	Embryonal
20.	Guibal and Goepfert [10]	1946	42	Right	Hours	Bilateral	Yes	Seminoma
21.	Bennet and Shaw [2]	1947	38	Right	2 days	Unilateral	Yes	Seminoma
22.	Charendoff [7]	1951	38	Left	3 days	Unilateral	Yes	Seminoma
23.	Kelly [12]	1952	3	Right	Hours	Bilateral	No	.....

* Table partially reproduced from: CHARENDOFF, M. D., BALLON, H. C. and SIMON, M. A. *J. Urol.*, 66: 274–279, 1951.

lower quadrant. Rectal examination may reveal tenderness in the same area. Typically, the patient has an elevated temperature, pulse and white blood cell count with a shift to the left. If there is a malignancy of the testicle, the presence of a mass may be of some help or it may further contribute to an erroneous diagnosis. In such cases it can be easily understood why the preoperative diagnosis might be that of acute suppurative appendicitis with perforation and localized abscess formation [7]. The duration of the symptoms is of little help to the physician, as they have been reported to be present for from a few hours to three weeks. Perhaps the only real clue is the presence of the foregoing signs and symptoms occurring in a patient who has either unilateral or bilateral cryptorchidism. In such patients it is necessary to ascertain the absence of any high scrotal, inguinal or perineal testis.

According to the authors of the previously documented cases of torsion of an intra-abdominal testicle, the diagnosis has never been made prior to surgical exploration of the abdomen. The following case is reported not only because of the rarity of the condition, but also because the correct diagnosis was made when the patient was initially examined.

CASE REPORT

A. C., a twenty-three year old white man, was admitted to the surgical service of San Joaquin General Hospital on May 9, 1956, complaining of lower abdominal pain of several hours' duration. The patient gave a history of having been well until two days before entrance to this hospital, when he awoke with pain in the right lower quadrant. The pain was localized immediately superior to Poupart's ligament; it was a persistent, dull ache which lasted about twelve hours and then spontaneously disappeared. The patient was nauseated during this period but there were no other symptoms. The next morning he again awoke with pain, which was more severe than previously but which was in the same location and

was also accompanied with nausea. The pain continued throughout the day and was associated with anorexia and one episode of vomiting. The patient had no preceding febrile reaction or history of trauma and there were no symptoms referable to the genitourinary system.

Physical examination revealed a well developed, well nourished, young, adult white man who did not appear acutely ill. He complained of severe pain in the right lower quadrant of the abdomen which was accentuated by any bodily movements. His head and thorax were essentially normal. Temperature, pulse and respiration were also normal. Abdominal findings included muscle spasm and tenderness in the right lower quadrant inferior to McBurney's point, lateral to the border of the rectus abdominis muscle and about 3 cm. superior to Poupart's ligament. Slight pain was referred to this same area when a rectal examination was performed. Examination of the genitalia disclosed a left testicle which was high in the scrotum, and an absence of the right testicle. There was no palpable mass high in the scrotum, inguinal canal or perineum to suggest an undescended or maldescended right testicle. While examining the right inguinal canal it was found that the site of maximum tenderness was in the inguinal canal immediately inside the external inguinal ring.

The blood count was 12,500 white cells per cu. mm. with 86 per cent segmented forms, 14 per cent lymphocytes and a hemoglobin of 93 per cent (13.5 gm. per cent). The urinalysis was negative with a specific gravity of 1.022. Sedimentation rate was normal.

The author's diagnosis was torsion of an undescended testicle, probably intra-abdominal. Other members of the surgical resident staff considered acute appendicitis as the most likely diagnosis, although torsion of a cryptorchid testicle was considered in the differential diagnosis.

After about three hours' observation the patient had increased nausea, vomiting and pain. Increased tenderness was noted on both abdominal and rectal examination. A repeat blood count showed a shift to the left and the patient was mildly febrile. He was then operated upon under intravenous pentothal® anesthesia supplemented with nitrous oxide and oxygen. The abdomen was entered through a long McBurney's incision extending as far medially as the rectus muscle. Immediately after entering the abdomen a hen's egg–sized mass was identified lying low in the pelvis. The mass appeared tense and shiny blue except at the superior pole, which was hemorrhagic. The entire structure was attached to a twisted pedicle. The pedicle was ligated and the mass was removed near its point of attachment to the peritoneum. Following this procedure a routine appendectomy was performed and the usual closure of the abdomen terminated the operation. After an uneventful postoperative course the patient was dismissed on the fifth hospital day with the wound edges healing well.

The pathologic findings (gross 56-988) were as follows: The specimen consisted of a soft mass which measured 5 by 4 by 3 cm. Approximately one-third of the surface was smooth, shiny and bluish in color. The remaining surface was covered with a fibrinous exudate. On sectioning, the portion of tissue underlying the smooth serosal covering was found to be testicle and measured 4 by 2.5 cm. The testicular tissue was a pinkish gray color in the peripheral portion, and the portion adjacent to the epididymis showed gross hemorrhage. The epididymis was completely distorted by the hemorrhagic changes. There was also a 3 cm. pedicle measuring 0.6 cm. in diameter.

Microscopic examination revealed sections of testicle with atrophic changes which were rather marked in the stroma. The interstitial cells were very prominent and there was some recent hemorrhage in the interstitial tissues. Sections of the epididymis revealed an extremely marked amount of hemorrhage into the interstitial tissues with edema of the fatty tissue. The epithelial lining was not remarkable. There was also a section of the vas deferens which did not appear remarkable.

SUMMARY

The literature regarding torsion of an abdominal testicle is reviewed. That the condition is a surgical rarity is attested by the fact that by 1952 only twenty-three cases had been reported in the world literature. Of these cases, there were only eight which occurred with testicles which were non-malignant. Some of the symptoms and clinical findings of the previously reported cases are discussed, illustrating why the condition is usually erroneously diag-

nosed as acute appendicitis. An additional case of torsion of an intra-abdominal testicle is discussed in this paper, bringing the total to twenty-four known cases. It represents the ninth instance of torsion of a non-malignant intra-abdominal testis, and is probably the first case in which the correct diagnosis was made preoperatively.

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Littre's Hernia

HYMAN SNEIERSON, M.D. AND JOHN R. CUNNINGHAM, M.D., *Binghamton, New York*

IN 1700 Littre described the presence of Meckel's diverticulum in a femoral hernia. Since then the presence of Meckel's diverticulum in a hernia sac anywhere is also called Littre's hernia. Watson [*1*] states that he collected 259 cases of which 143 were inguinal, 54 femoral and 32 umbilical. Payson [*2*] stated that up to 1954 only thirty-five cases of strangulation in a femoral type of Littre's hernia had been reported; he added an additional case. We wish to report a case of strangulated femoral hernia (Littre type). This patient was operated on in 1948 and a strangulated femoral hernia of simple type occurred on the opposite side in September, 1956. We also had an additional case of Littre's hernia in a simple inguinal sac in February, 1956.

CASE REPORTS

CASE I. This fifty-one year old white man was admitted to the Binghamton City Hospital on April 4, 1948, with a history of pain and vomiting of twelve hours' duration. He had a normal bowel movement on this date. There were no urinary symptoms. He stated that he had had a lump in the groin intermittently for three years. This did not bother him as it was always reduced easily. On this date, however, the lump could not be reduced and he began having severe abdominal cramps and vomited repeatedly. The attacks were becoming more frequent. Temperature was normal, as was blood count and urinalysis. Physical examination showed the abdomen to be soft with no soreness and with normal peristalsis and auscultation. A lump the size of a golf ball was present below the right Poupart's ligament. This was quite sore but there were no signs of inflammation. A diagnosis of strangulated femoral hernia was made and surgery was performed with the patient under spinal anesthesia. A right parainguinal incision was made. The fascia was cut and the cord and the inguinal canal explored. The tissues were edematous but otherwise normal. A mass was present extending through the femoral canal. The peritoneum was opened and a moderate amount of clear fluid was noted. There seemed to be no angulation of bowel which seemed adherent to the femoral canal opening. The opening was small, necessitating cutting the femoral ring near the pubis. The neck of the sac was then cut and a Meckel's diverticulum was delivered about 1½ inches long and ½ inch in diameter. This was markedly inflamed and dark purple in color. The adjacent ileum seemed perfectly normal and therefore the diverticulum was excised by a transverse incision and closed with an inverting layer of catgut plus a layer of interrupted silk. The femoral canal was obliterated in part by uniting the transversalis fascia and Cooper's ligament to Poupart's ligament. Convalescence was uneventful.

In September, 1956, this patient was seen again with the same signs and symptoms on the right side. A strangulated femoral hernia of the simple type was found and repaired as described previously.

CASE II. This forty-two year old white male laborer sustained a hernia three years prior to admission while at work. He had tried to wear a truss on several occasions because of a fear of surgery, but had to remove it due to a severe pain in the groin and a feeling of nausea. For the past three months the pain had become more severe and had been accompanied by severe cramps. There were no gastrointestinal symptoms aside from the cramps and slight nausea which had gradually become worse. Examination showed the presence of a large scrotal hernia on the right. On February 15, 1956, at operation, a large scrotal type hernia was found. Examination showed an incarcerated Meckel's diverticulum as well as a large amount of omentum. The diverticulum was

excised by a transverse incision in the bowel with an inverting layer of No. 2-0 and 4-0 interrupted chromic silk for the skin. A routine McVey-Bassini type of repair was performed using cotton throughout. The Meckel's diverticulum was reported as being 5 cm. in length and 3.5 cm. in diameter. Microscopic examination showed inflammation in normal small intestinal type of lining.

The presence of the diverticulum may have contributed to the symptoms but the exact amount is questionable.

COMMENTS

The signs and symptoms of Littre's hernia are the same as in any femoral hernia. If no strangulation occurs the symptoms are merely that of a lump in the groin, constant or only present intermittently. Theoretically, strangulation should result only in local signs and symptoms if only the diverticulum is caught, since the lumen of the bowel proper is not infringed upon. Actually this gives much the same symptoms as Richter's hernia plus a local mass, with signs of marked nausea, vomiting and even shock. Cases have been reported, however, in which the patient when first seen presented a fecal fistula in the femoral canal, suggesting infection or sloughing of the diverticulum with drainage extraperitoneally below Poupart's ligament. A diagnosis of strangulated femoral hernia is especially indicated when there are signs and symptoms of intestinal obstruction with no scars on the abdomen and no masses felt abdominally. When the patient is thin and the mass tender, the diagnosis is easy. When the patient is obese, the cause of the symptoms is easily missed. We have been misled frequently enough so that careful examination of the inguinal and femoral rings is routine in all abdominal cases, especially when the diagnosis is not clear-cut. This is especially indicated when there are symptoms of intestinal obstruction with no scar on the abdomen.

Payson [2] states that the "inflammation, fever, and pain which accompany these types of herniae are less severe and occur late." Unless missed for a long time, fever and inflammation should not often be present. In our case there was no elevation of temperature and no signs of inflammation beyond the local mass which would necessarily be present in all such cases, especially if strangulated. We feel that the diagnosis can only be made at operation and even then might conceivably be missed if the hernia is attacked below the inguinal ring and reduced prior to opening the sac. We routinely use the suprainguinal approach exactly as we do in an inguinal hernia and as seems to be generally advocated. We always open the peritoneum and examine the hernia from within. The desirability of this approach is self-evident in cases of strangulation.

Recurrences in femoral hernia vary from 4 to 8 per cent [1]. In order to prevent this we routinely close the inguinal canal at the lower third by suturing Cooper's ligament to the transversalis fascia and Poupart's ligament only. We have had no recurrences in the pubic region since using this technic.

Payson [2] reported the presence of ectopic tissue in the diverticulum in his patient. This caused no symptoms, however. He did not report any case in which this in any way complicated the Littre hernia. This can only be due to the rarity of the cases reported since hemorrhage from gastric tissue in Meckel's diverticulum is not uncommon. (We have had several [3].) The location would not prevent hemorrhage or inflammation.

The treatment of Meckel's diverticulum in a femoral hernia is the same as that when found elsewhere and causing symptoms. It is removed alone or with the adjacent bowel, when indicated, by a transverse excision in order not to infringe on or narrow the lumen.

SUMMARY

1. A case of strangulation of Meckel's diverticulum has been reported and the literature reviewed.

2. An additional case of Meckel's diverticulum as an incidental finding in a scrotal type of inguinal hernia is also reported.

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New Biopsy Needle

REPORT ON AUGER TYPE INSTRUMENT FOR OBTAINING TISSUE SPECIMENS

H. I. BIEGELEISEN, M.D., *New York, New York*

THE securing of specimens within the body structure has always been an important part of diagnosis. In tumor differentiation and for the study of other disease processes the needle method has often been the only practical means of investigating tissue pathology without surgery. Growths or disease in areas like the breast, liver, lymph glands, spleen, lung, prostate, brain, muscle and other even more inaccessible regions have frequently yielded their secrets to the biopsy needle. In spite of its importance, however, there has been no radical change in biopsy needle construction for many years.

Curiously enough, I was originally prompted to improve the existing biopsy instrument as the result of my work on lymphedematous legs. In 1936 I published an injection treatment for lymphedema [*1*] in which isotonic solutions were injected subcutaneously using large bore needles of 13 gage diameter. The success of this therapy led me to investigate the possibility of further improving the technic by coring out actual tissue segments in lymphedematous legs for the purpose of developing anastomoses between the superficial and deep lymphatic systems. None of the existing equipment was able to perform this with any degree of success. I was stimulated to develop a new type of needle which would remove a section of indurated tissue cleanly and consistently without undue trauma.

During the years that followed many models were tested in conjunction with leading instrument makers, without success. Recently I successfully combined my efforts with the engineers of the MacGregor Instrument Company, Needham, Massachusetts, to produce a new needle which secures a cleanly cut specimen every time it is used.

From the beginning it was apparent that what had started as an instrument to treat lymphedematous legs was in effect a much more important universal tool, namely, a new biopsy needle of widespread utility.

This needle was named the Vim auger needle because of its construction features. (Fig. 1.) It is made up of three parts: the cutting needle, an outer cannula and an obturator. The cutting needle is unique in that it has at its tip a specially designed spiral screw-like cutting thread. The point of this threaded needle has a sharpened tip which facilitates entry into the tissues. At the upper end of this cutting needle is another thread topped by a knurled grip. This upper spiral is not for cutting but for controlled feeding of the needle as it is advanced inside the cannula into the tissues.

The outer cannula and its obturator are not remarkable except that a spring clip has been fastened to the cannula in such a fashion as to engage the guiding threads of the cutting needle while it is being advanced into the tissues.

The mode of action is as follows: The cannula and obturator, which may be 13 gage or smaller, when assembled present a smooth beveled cutting edge in the usual fashion. After

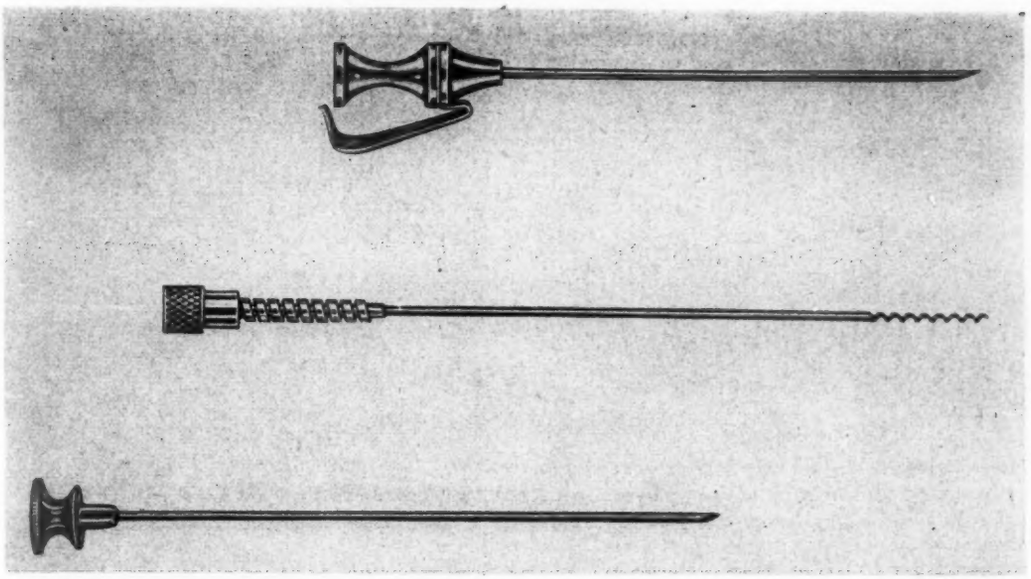

FIG. 1. Vim auger needle (Biegeleisen), shows three parts: *Top*, outer cannula; *middle*, cutting needle with cutting threads and guiding threads; *bottom*, obturator.

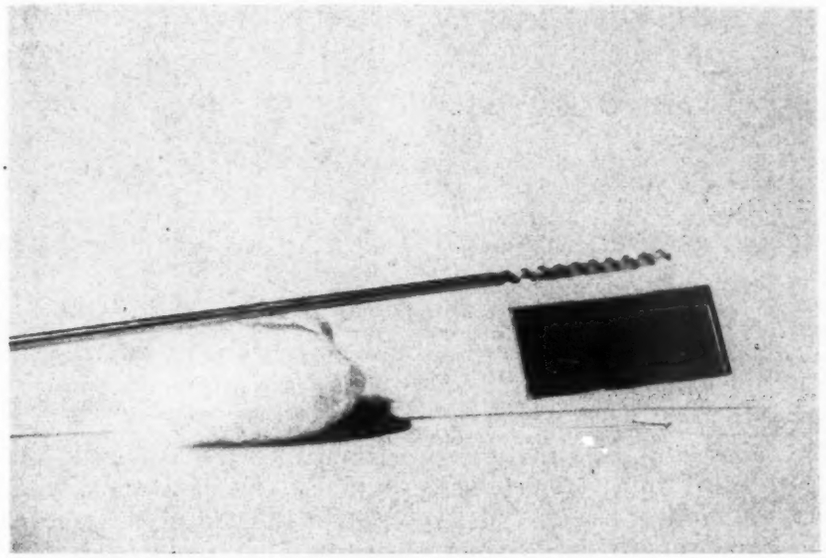

FIG. 2. Photograph showing spirally cut specimen of tissue in the grooves of the cutting needle. Note length of specimen is ¾ inch.

preliminary local anesthesia these two units are inserted through the skin, up to the growth or area under investigation, but no further. This may be only ¼ to ½ inch where subcutaneous specimens are sought. For deeper-lying areas the cannula and obturator will have to be inserted for greater distances.

The next step in this technic is the insertion of the cutting needle. The cannula is kept in position and the obturator removed. The cutting needle is pushed into the cannula down to its end. At this point the tip of the cutting needle is adjacent to the tissue under investigation.

Controlled cutting of the specimen may now be started. The needle is screwed into the tissues with one hand while with the other the spring clip is kept in engagement with the upper feeding threads. The length of the specimen will depend on the depth to which the cutting needle is advanced. The position of the spring clip in relation to the number of threads

FIG. 3A. Low power view of spiral cutting from lymphedematous leg. Note preservation of tissue layers.

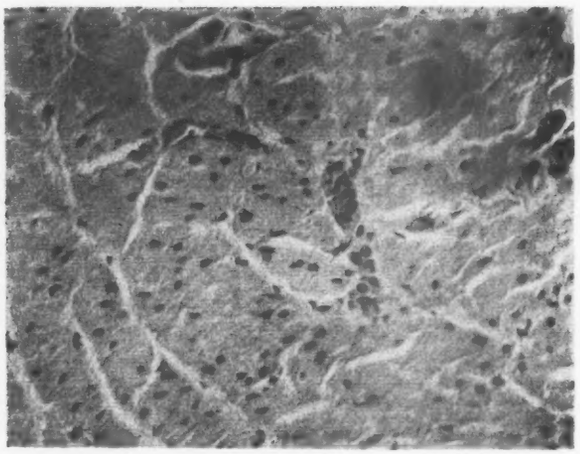

FIG. 3B. High power view of lymphedematous leg. Note fibrosis. Dense tissue easily cut with biopsy needle. Original magnification × 450.

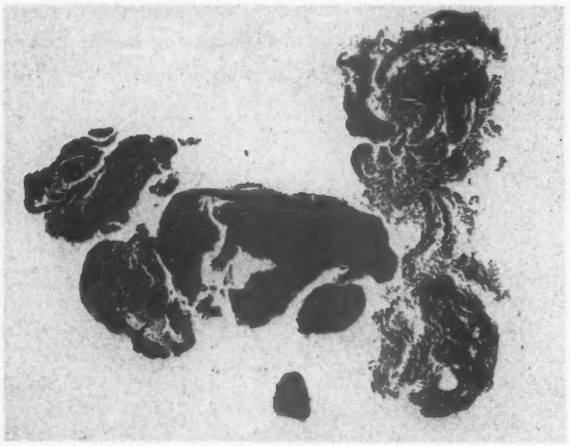

FIG. 4A. Low power view of cervical lymph node. Tissue structure clearly identified in cuttings.

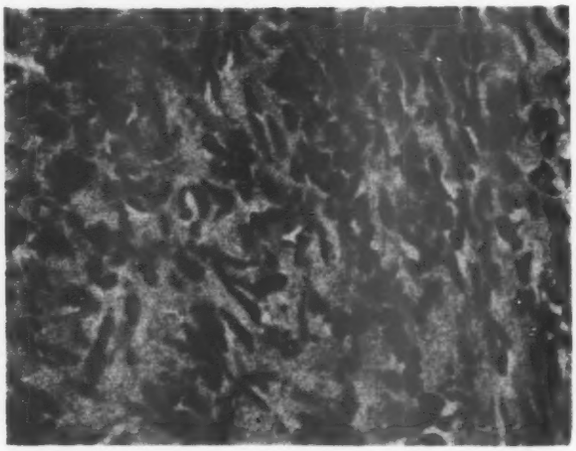

FIG. 4B. High power view of tissue cells of suspicious lymph node. Original magnification × 850.

will immediately indicate the depth of the cutting action. Specimens up to 7/8 inch may be obtained.

The next step is the freeing of the specimen. Holding the knurled grip firmly in one hand so as to keep the cutting needle motionless, the outer cannula is forcibly pushed deeper into the tissues. During this maneuver the spring clip is released from its engagement with the spiral groove. The beveled cannula tip cleanly cuts the specimen from its surrounding attachments. None of it can be left behind because it is firmly caught within the spiral grooves of the cutting threads.

The outer cannula must be pushed past the cutting threads, at which point a lack of resistance is clearly felt. The cutting operation is now finished and both needle and cannula are simultaneously removed from the area. A spirally cut specimen of tissue will be consistently found in the grooves of the cutting needle. (Fig. 2.) It can be removed simply by rotating the needle while holding the specimen between two fingers or a piece of gauze.

The reason for the unvarying success of this new biopsy needle lies in the fact that the desired tissue is unfailingly penetrated by the cutting needle and held. The material cannot escape or be left behind as in other needles because it is firmly caught in the cutting grooves even before the cannula is advanced over it. The cannula completes the procedure, cutting off any remaining attachments of the specimen to the tissues. Surprisingly enough the procedure is simple and may be executed by any physician without assistants. Facility of execu-

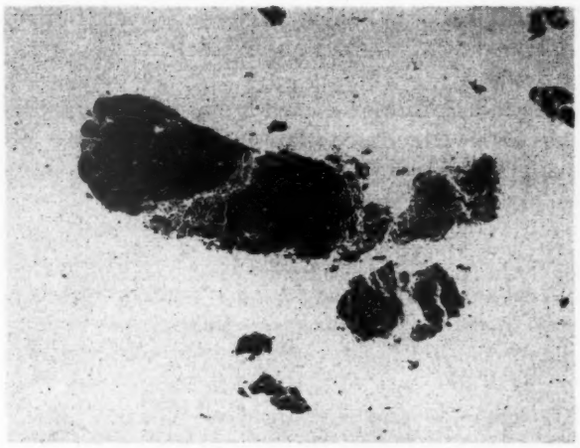

FIG. 5A. Carcinoma. Low power view of right lumbar mass. Note dense tissue.

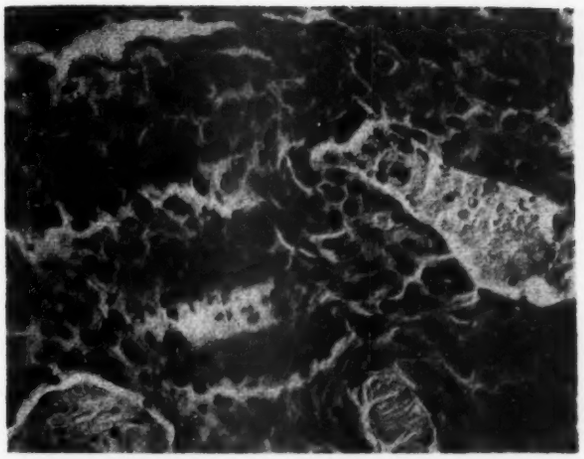

FIG. 5B. High power view clearly shows necrotic squamous cell carcinoma. Original magnification × 450.

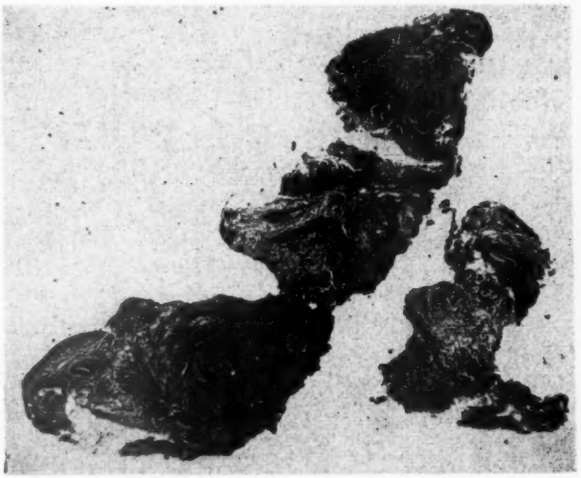

FIG. 6A. Low power view of cuttings from cancer of the breast. Note spiral shape compatible with identification. Original magnification × 30.

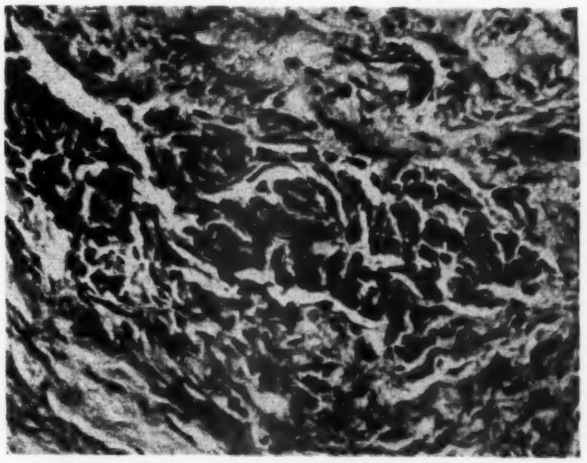

FIG. 6B. High power view shows cancer tissue clearly and illustrates versatility of auger biopsy needle. Original magnification × 450.

tion will be improved with practice, but even the novice will obtain a specimen with his first trial.

This biopsy needle will cut anything from soft fat to the hardest sclerotic tissues. It will secure a specimen from any tissue that the needle can penetrate. Figures 3, 4, 5 and 6 represent sections from areas of varying density and accessibility. Figure 3 shows a cutting from dense tissue in an advanced case of lymphedema. Previous biopsy needles were unable to deal with this dense type of tissue. Figure 4 represents a section of a suspicious cervical lymph node. Figure 5 is from a lumbar mass which proved to be necrotic squamous cell carcinoma. Cancer of the breast can be seen in Figure 6. The range of tissue hardness in which the needle may be used is therefore very wide. Furthermore, the versatility of the needle in different areas is amply demonstrated. Low power illustrations are included to show the practicability of identifying spiral cuttings.

Specimens obtained may be sectioned or smeared depending on the tissue consistency and the type of study wanted. The spiral shape does not impede the usual sectioning procedures and subsequent staining for microscopic study. I have used the auger needle in over 200 cases during the past year. Recent clinical trials in the Mt. Sinai and Memorial hospitals of New York City have demonstrated its effectiveness, as specimens were obtained with the first trials. At the present time the needle is made in 13 gage thickness, but smaller sizes will be

available which may be more suitable for biopsies of the liver.

CONCLUSIONS

1. A new biopsy needle working on a radically different auger principle has been developed.
2. The needle consistently secures specimens under widely varied conditions anywhere in the body.
3. Specimens are cleanly cut without undue trauma.
4. The biopsy specimen cannot be left behind in the tissues, as it is always held between the grooves of the cutting edge.
5. No training is necessary in using this needle. The technic is simple and specimens will be obtained with the first attempt.

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A Vise-Retractor for Mid-thigh Amputations

WILLIAM P. CORRIERO, M.D., *Garden City, New York*

THE need for cutting the femur adequately high in order to form a good stump in mid-thigh amputations is known to all surgeons. That this purpose is often defeated because of poor or difficult retraction of soft parts is also well known. This difficulty has been obviated in great part by the use of the vise-retractor described herein.

The vise-retractor is an instrument which consists of two simple parts requiring no mechanical adjustments or manipulations. Each part is a flat piece of metal or plate about ⅛ inch thick and shaped in the form of similar and equal triangles. One homologous side of each plate is a straight edge about 9 inches long. The remaining two sides, about the same length, form curved edges with their convexities toward the body of the triangle. On the straight edge and as an integral part of each plate are the component parts of three "come-apart" hinges, the right plate the male components and the left plate the female components. On the upper third of each straight edge is a semi-circular notch of ⅞ inch radius. (Fig. 1.)

When the plates are brought together along their straight edges and held in a single plane, the male and female components are engaged to hinge and the matched semi-circular notches form a circular hole for the femur to pass through. Once the plates begin to swing backward toward each other they cannot pull apart or disengage. (Fig. 2.)

The instrument is used in the following manner: After the soft parts have been cut and the bone has been stripped to the level of amputation, the retractor is held with the straight edge of each plate to each side of the bone. Holding them in a single plane, the edges of the plates are brought together and the hinges engaged, the femur passing through the circular hole. (Fig. 2.) A hand is placed above and below; and holding the engaged plates in a single plane at a right angle to the femur, the soft parts are retracted upward by pushing up along the bone to the level of amputation. At

FIG. 1. Shows the retractor-vise disengaged. On the opposing straight edge of each triangle are the three elements of the come-apart hinge, the male component in the operator's right hand and the female component in the left hand. Opposing semi-circular notches are in the upper third of the instrument.

FIG. 2. The bone stripped of all soft tissues, the retractor-vise is in position to be applied. The plates held in a single plane can be engaged one with the other. The bone passes through the round hole formed by the semi-circular notches.

FIG. 3. The assembled retractor held in a single plane can be pushed upward to retract the soft tissues. When retraction is adequately high, the retractor is swept backward thus narrowing the round hole until its edges impinge on the bone, to hold it in a vise-like grip. Note the tripod-like stability obtained because of the convexity of the lower edge of the plates.

FIG. 4. Final step in severing the bone. By cutting upward first for about ¼ inch, splintering of the bone can be avoided.

this point an assistant holding the opposite apex of each plate folds them back toward each other to form a V. (Fig. 3.) This causes narrowing of the circular hole until the lateral edges of this hole impinge upon and clamp the femur. No further retraction is now necessary and the retractor will not slip forward, for as long as the plates are folded backward the femur is in the vise-like grip of the narrowing hole.

The bone can then be sawed off (Figs. 3 and 4) at the window through which the femur passes. Release of the folding action will allow the plates to become disengaged.

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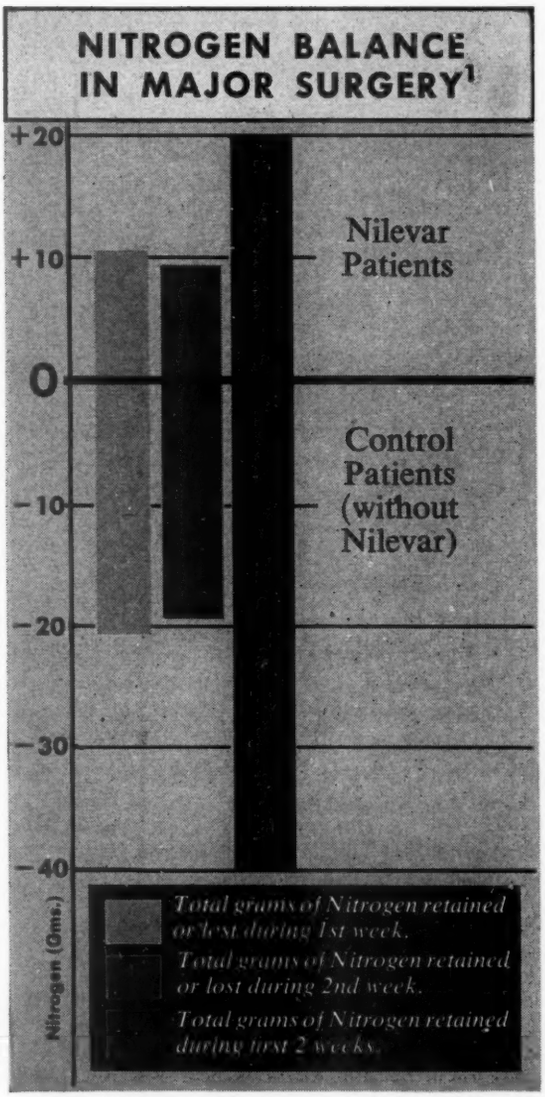

"Loss" and "lack" hypoproteinemia[3] frequently occur in the surgical patient. Factors which increase nitrogen loss may be direct as in hemorrhage from peptic ulcer or loss of serum from burned surfaces. On the other hand, hypoproteinemia may develop in surgical patients because of their inability to ingest or to assimilate sufficient nutriment.

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SEARLE

"A. P. L." therapy in cryptorchidism is now considered at an earlier age

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There are widely divergent views on the management of cryptorchidism. However, many practitioners now believe that an early descent of the testes is essential if spermatogenesis is to be preserved. Furthermore, higher doses than formerly used are now recommended on the basis that these will produce a greater incidence of satisfactory responses.[1] In a recent issue of the Journal of the American Medical Association, an editorial suggested a therapeutic trial with chorionic gonadotropin when there is evidence of testicular hormone deficiency[2] such as obesity, signs of feminism or enlarged breasts.

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[2] 1,000 I. U., three times weekly, for six to eight weeks.

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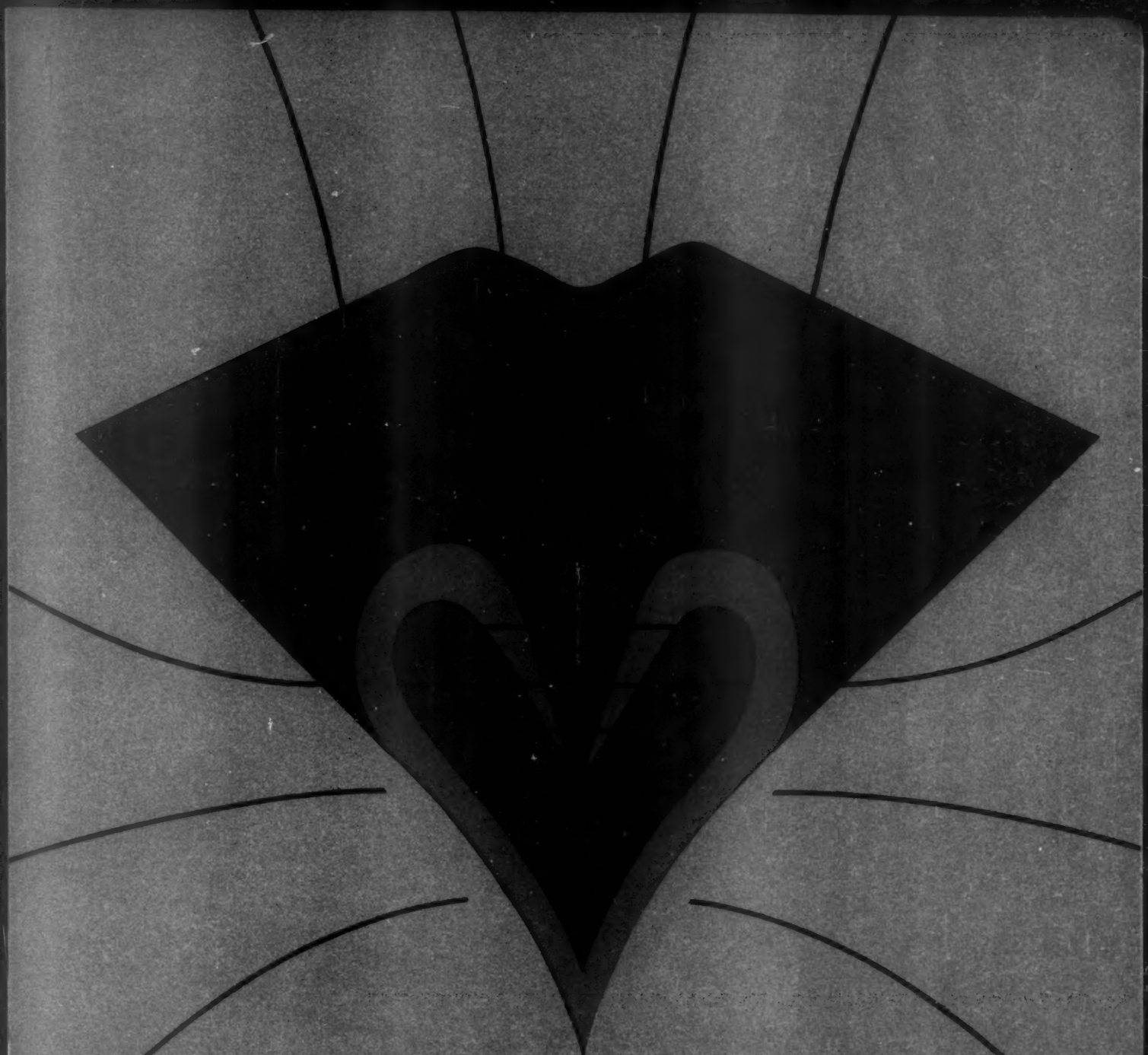

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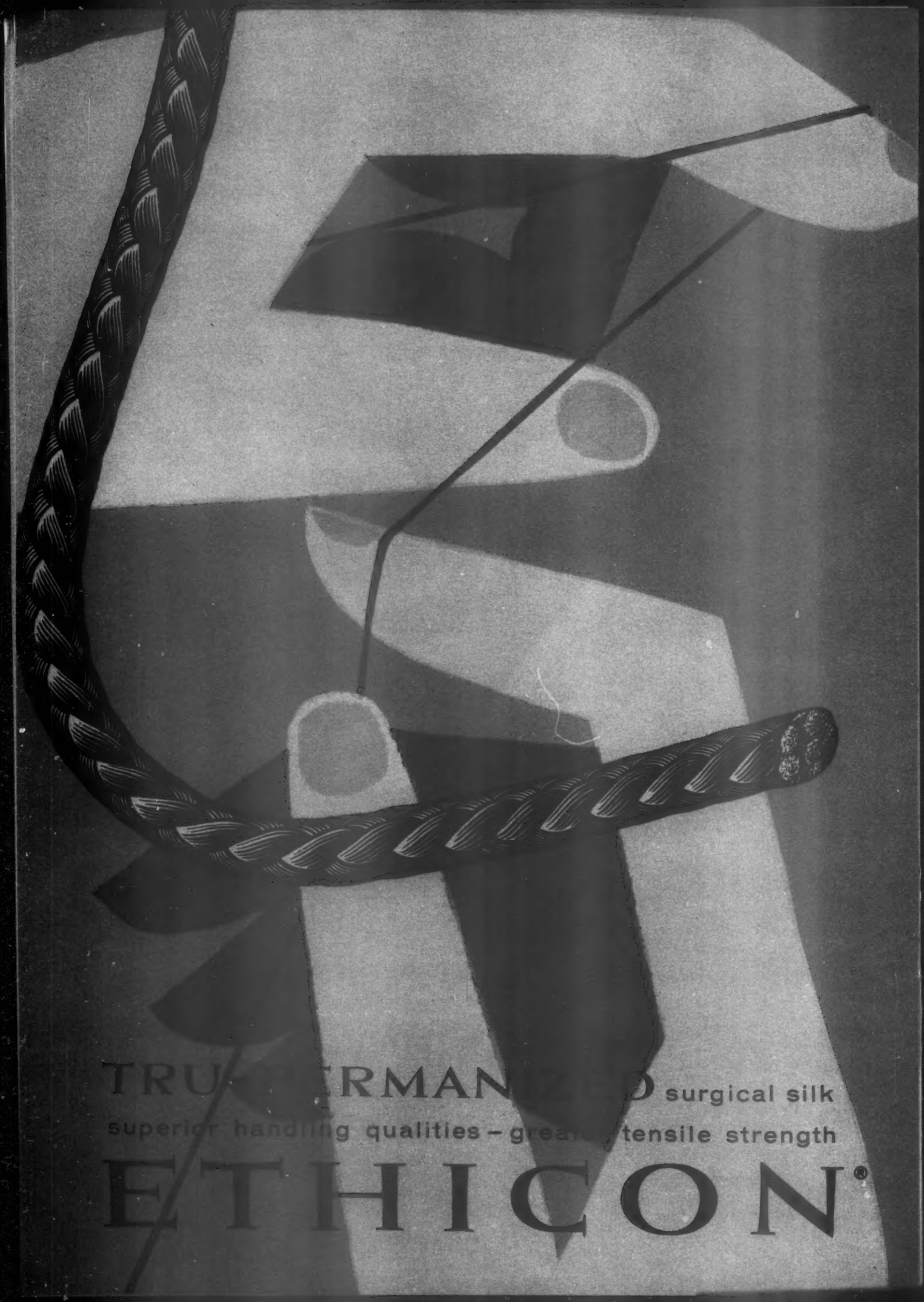
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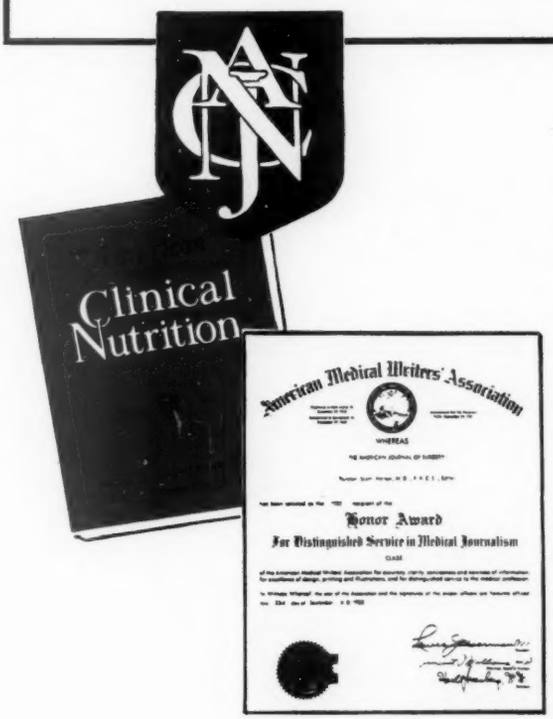

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**Elman, R.; Protein Needs in Surgical Patients, J. Am. Dietetic Assn. 32;524 (June) 1956.*

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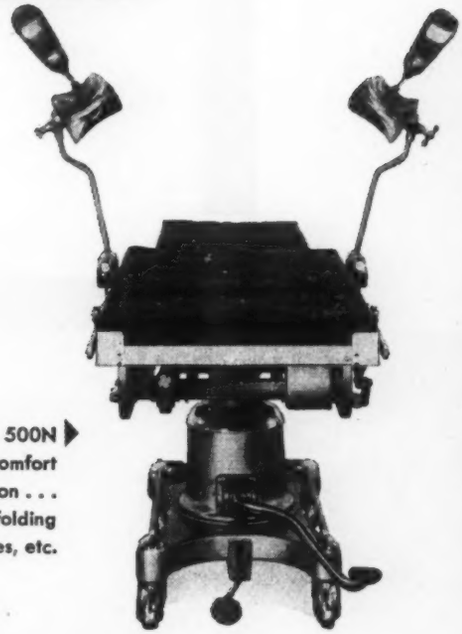

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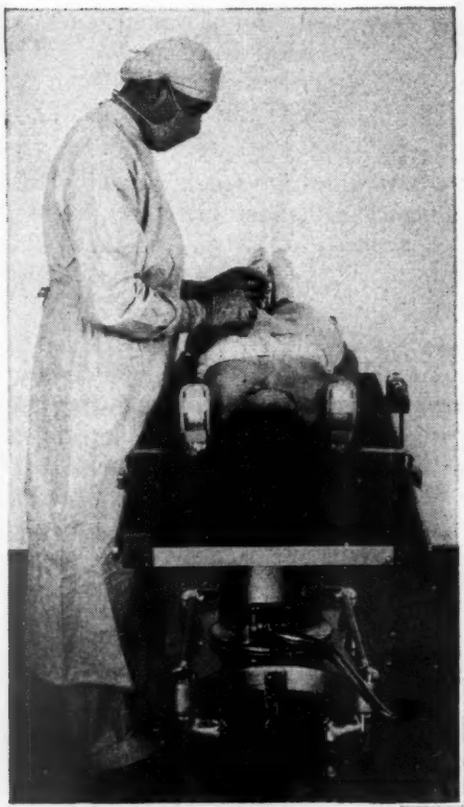

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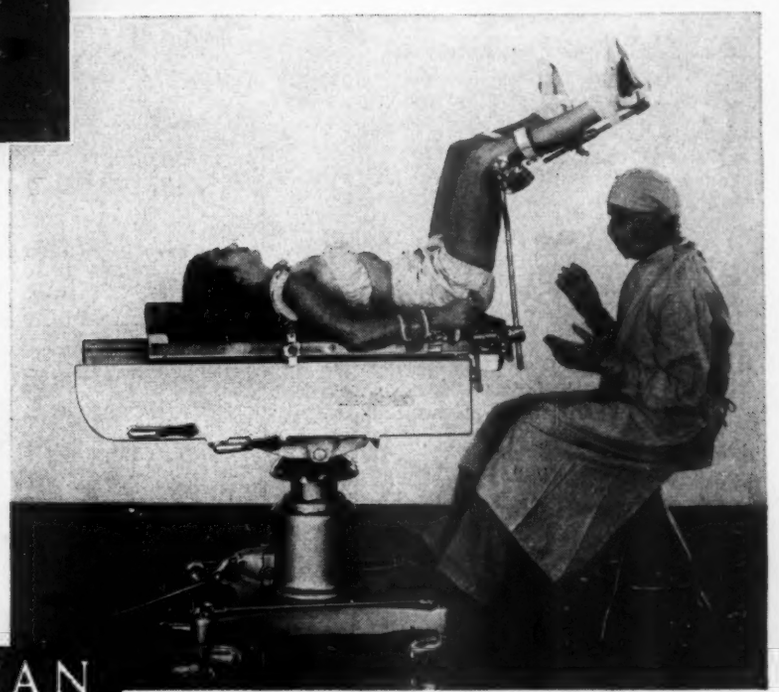

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*Lawrence, E. D.; Doktor, D., and Sall, J.: Angiology 2:405, 1951.

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1. Odell, W. M.: Nutrition in Cardiovascular Disease, in Wohl, M. C., and Goodhart, R. S.: Modern Nutrition in Health and Disease, Philadelphia, Lea & Febiger, 1955, p. 699.
2. Bills, C. E.; McDonald, F. G.; Niedermeier, W., and Schwartz, M. C.: Sodium and Potassium in Foods and Waters, J. Am. Dietet. A. *25*:304 (Apr.) 1949.

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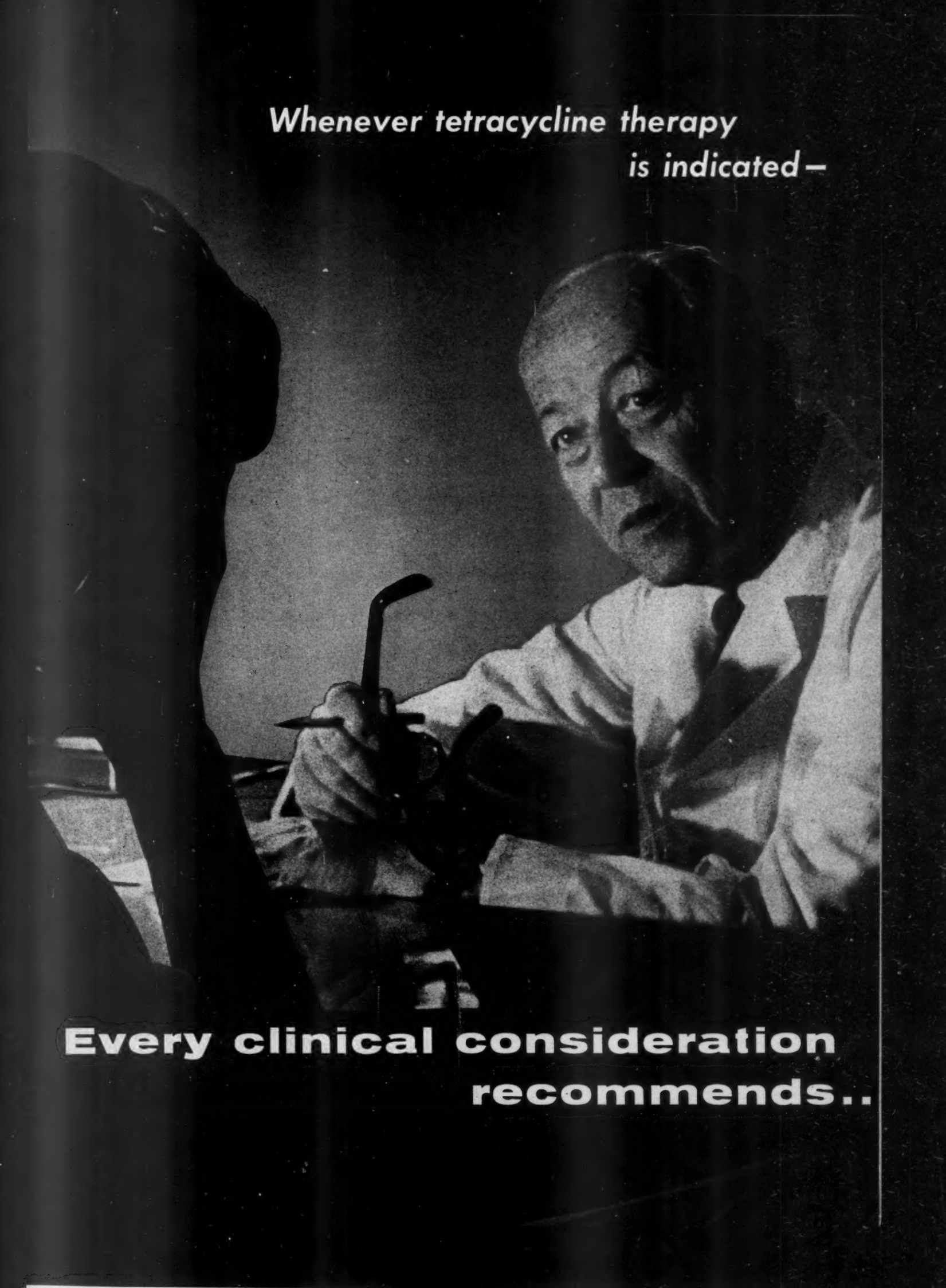

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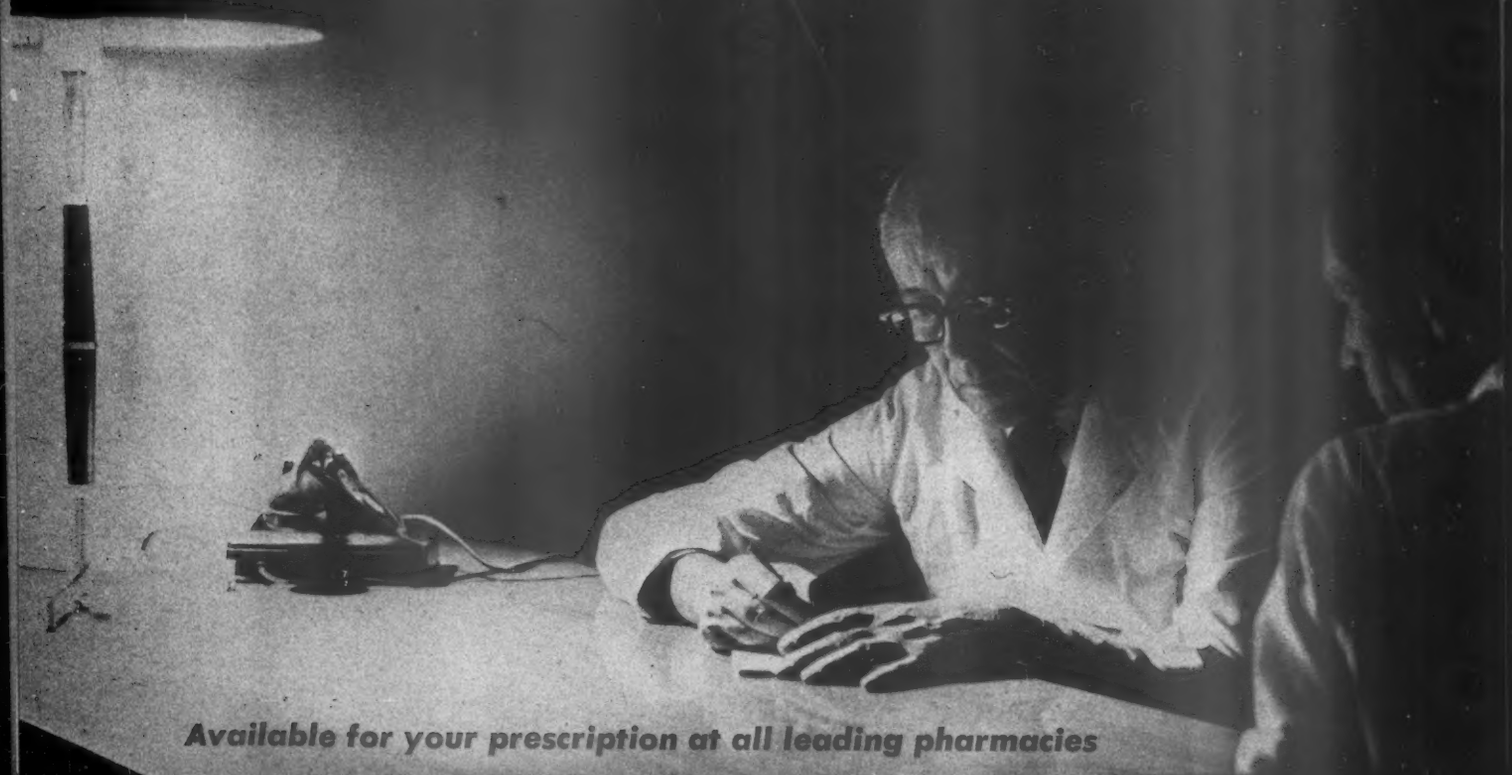

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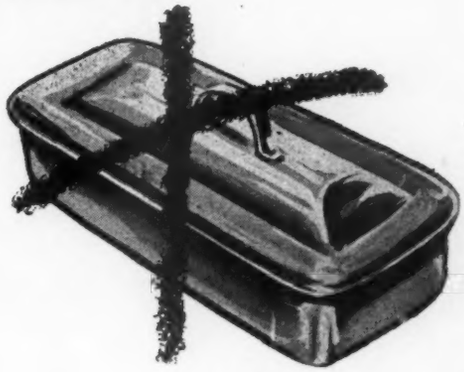

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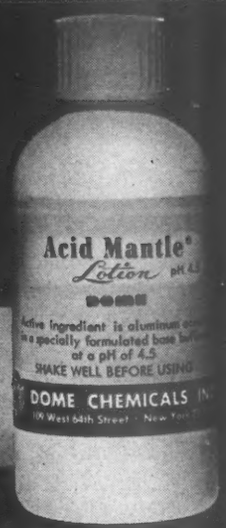

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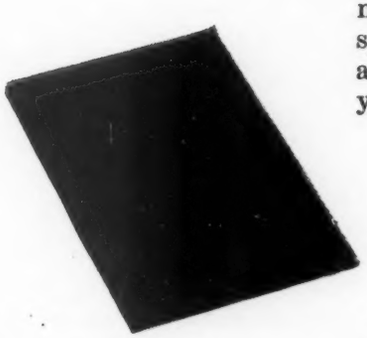

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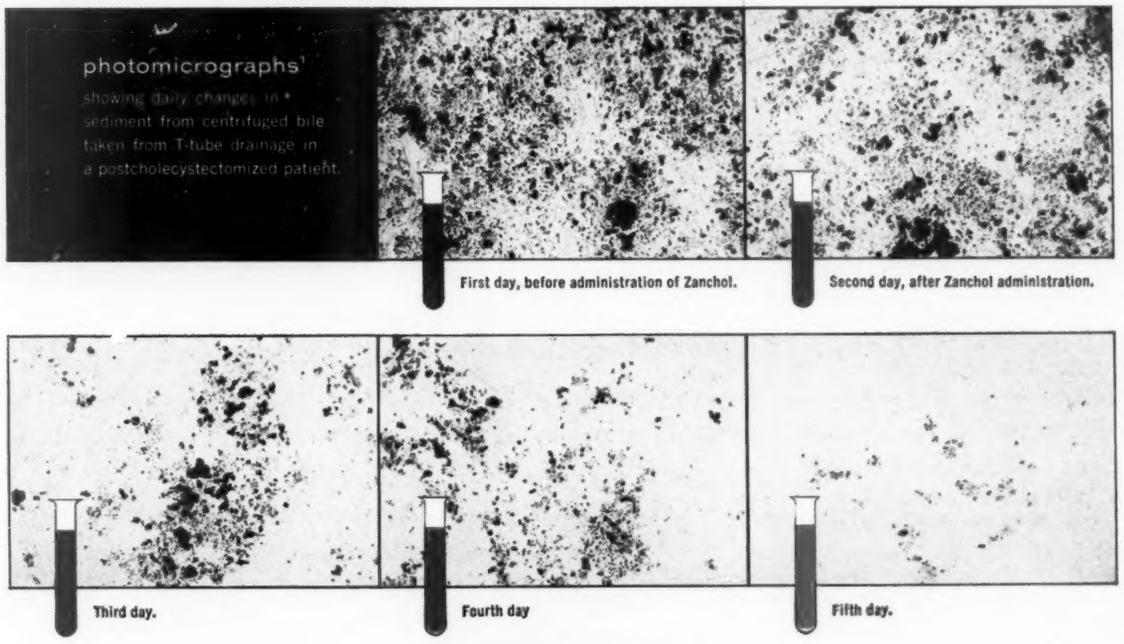
1. McGowan, J. M.: Clinical Significance of Changes in Common Duct Bile Resulting from a New Synthetic Choleretic, Surg., Gynec. & Obst. *103*:163 (Aug.) 1956.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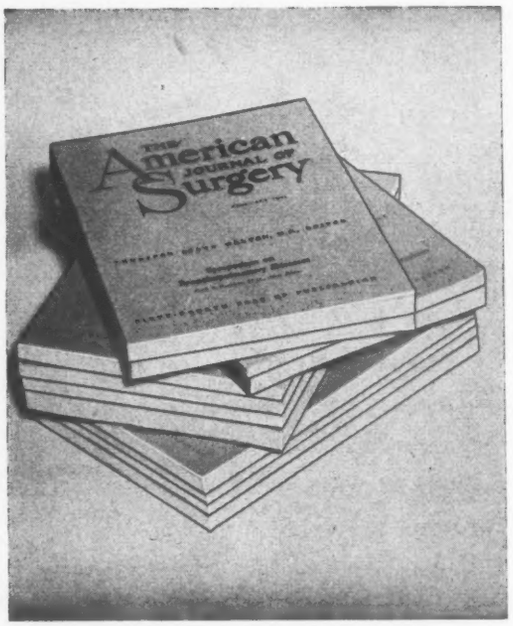

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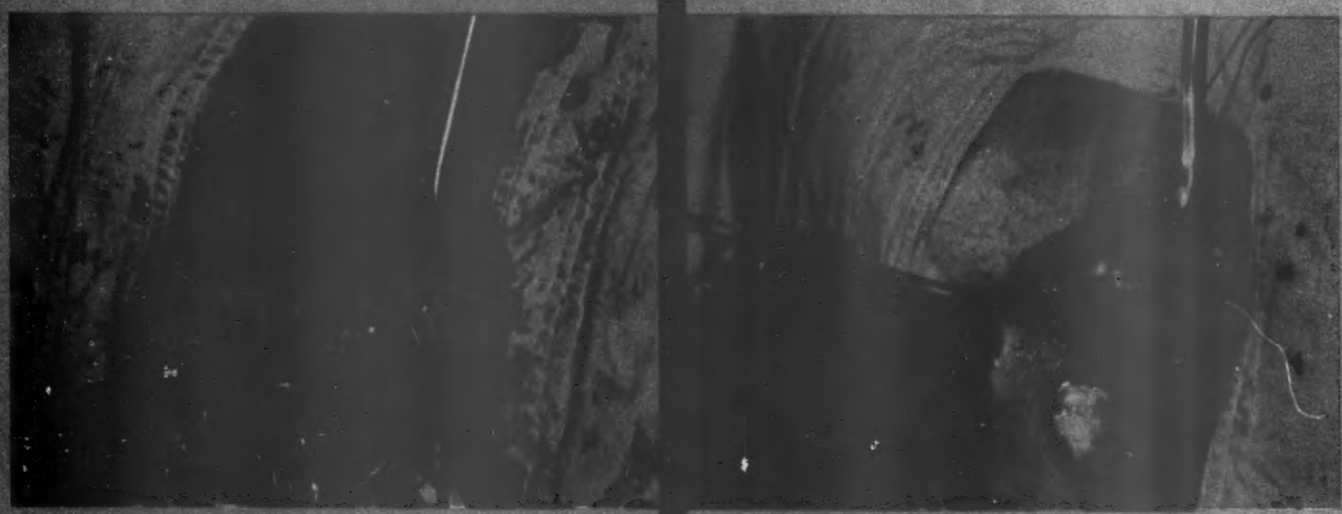
1. Riddle, A.C., Jr.: Adrenosem Salicylate: A Systemic Hemostat, Oral Surg., Oral Med., Oral Path. 6:617 (June, 1953).



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NOTES AND QUOTES

THE antimalarial drug aralen® (chloroquine) was termed by a Canadian rheumatologist the only known medication for rheumatoid arthritis which seems to attack the total disease itself rather than the inflammation caused by it. The physician-researcher, Dr. Arthur W. Bagnall of Vancouver, British Columbia, stated that aralen completely suppressed the disease in a large number of patients he treated. His report was made at the 9th International Congress on Rheumatic Diseases, which met in Toronto. The recently held meetings were attended by more than 1,000 specialists from all parts of the world, including representatives of the Soviet Union and other Iron Curtain countries. Results of other studies with aralen, produced by Winthrop Laboratories, were also called extremely effective and virtually harmless by research scientists in the U. S. and Roumania.

A safer and easier-to-use administration set for transfusions of blood, plasma or serum has been introduced by Abbott Laboratories, North Chicago, Illinois. The new disposable set has a bulb-shaped pump which permits the administrator to control instantly the rate of fluid flow to the patient.

To administer a steady stream of fluid, the operator squeezes the bulb. The rate of flow depends upon the pressure exerted on the bulb. When the bulb is released, the fluid returns to drip administration at a predetermined rate. The drip chamber does not flood, so the administrator can easily observe the rate of drip or flow.

Because pressure ends when the bulb is released, the new pump is safer than systems using compressed air. Other safety features include a check valve between the pump outlet and the patient to prevent withdrawal of blood from the patient, and placement of the filter in the drip chamber instead of in the pump so that pressure is not applied to unfiltered blood.

The pump is located 12 inches below the drip chamber within easy reach of the administrator. About 25 squeezes of the pump, which has a capacity of 30 cc., will empty a 600 cc. container of fluid.

The blood pump administration set can be used with any plug-in type fluid container. It can be employed continuously by transferring from an empty to a full container.

A MEDICATED chewing gum has been developed by Orabiotic-White Laboratories containing the antibiotics, neomycin sulfate and gramicidin, plus a local anesthetic propesin. The combination of antibiotics offers a broad spectrum of antibacterial action with a low degree of sensitization, the anesthetic produces marked relief from pain, and the chewing motion elicited by the gum provides much desired exercise of the throat muscles.

Duke Laboratories, Inc., manufacturers of the original elastoplast® bandages have developed a new ventilated and porous elastoplast bandage: striated-vented elastoplast available in 2, 3 and 4 inch widths by 5½ yards stretched lengths.

The adhesive stria extend the length of the bandage with parallel intercostal spacing that provides full ventilation, evaporation of perspiration and release of exudates.

Adequate adhesion is supplied in the manufacture of this bandage, yet a minimum of adhesive mass comes in contact with the skin. Added patient comfort is assured even during lengthy periods of re-dressing.

WIDESPREAD supplementation of breads and cereals with the essential amino acid lysine, which raises the protein quality of wheat foods to the level of meat and milk, would help combat two major nutritional problems in the United States.

Writing in the *International Record of Medicine*, Dr. J. W. Brown, of E. I. du Pont de Nemours & Co., Inc., described these problems as (1) the nutritional health of families in low income groups who cannot afford expensive high quality protein foods; and (2) the changing dietary patterns created by "the abundance of our mechanized age."

Dr. Brown reported that breads and cereals supplemented with lysine would provide an inexpensive source of high quality proteins for people in lower income brackets, who may depend on cereal foods for as much as 40 per cent of their daily protein.

But an even larger problem is posed, Dr. Brown said, by the changing dietary patterns resulting from the wide use of labor-saving devices in the home and automation in the factories, which have caused a decrease in the

CONTINUED ON PAGE 54

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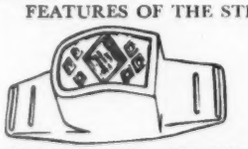

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energy requirements of large segments of our population. From a nutritional standpoint, he added, it was therefore inevitable that obesity should arise as a major health hazard, since a decreased need for energy frequently does not diminish the appetite for calories.

This has resulted in a growing trend to combat obesity by cutting back caloric intake to approximate energy utilization more closely. However, the recommended dietary allowances proposed by the National Research Council indicate that the needs of the human adult for protein do not diminish with a decrease in caloric requirements. Thus, if a smaller amount of food is consumed, the diet should be proportionately richer in high-quality protein—in breads and cereals, as well as in meat, milk and eggs.

Opposition to water fluoridation "will disappear like a bad dream once citizens make it their business to learn the facts," Dr. Louis I. Dublin, public health authority and consultant to the Institute of Life Insurance, predicts in a pamphlet, "Water Fluoridation: Facts, Not Myths," published recently by the Public Affairs Committee, a nonprofit, educational organization located at 22 East 38th Street, New York City.

"Today many millions of children are being deprived of the advantages water fluoridation could furnish them," Dr. Dublin says. "This deprivation is due in part to the familiar resistance of suspicious people whose counterparts once opposed vaccination and pasteurization."

In a foreword, Dr. Benjamin Spock, pediatrician and author, agrees that "fluoridation has become a controversial issue not because any detriment has been proved from its use but because the idea is frightening to some individuals" and adds that "the antidotes for these baseless fears are scientific data and public education."

Water fluoridation is described by Dr. Dublin as "the most effective and least costly preventive dental health measure available." He adds that "it is completely safe."

"Research has repeatedly verified the fact that between one-half and two-thirds of new tooth decay is prevented by nourishment from conception and birth with fluoridated water," he says, adding that "older people who have been drinking naturally fluoridated water all their lives have substantially fewer decayed, missing and filled teeth than people of the same ages whose drinking water has had insufficient fluoride protection."

Indicating the tremendous savings that a community can effect through water fluoridation, Dr. Dublin points out that next to the common cold, tooth decay is "probably the most universal disease suffered by mankind."

THE PUBLIC HEALTH SERVICE said recently that there is increasing evidence that excessive cigarette smoking is one of the factors which can cause cancer of the lung. The statement by Surgeon General Leroy E. Burney modified somewhat the previous official position taken by the Public Health Service in 1954 on the question of cigarette smoking and cancer of the lung. At that time, the Service noted there was some evidence of a statistical association between cigarette smoking and cancer of the lung but left open the question of whether there was a cause and effect relationship.

In his recent statement Dr. Burney said many independent studies have confirmed beyond reasonable doubt that there is a high degree of statistical association between cancer of the lung and heavy and prolonged cigarette smoking. Although this evidence is still largely statistical in nature, some laboratory studies also support the concept of a cause and effect relationship.

Dr. Burney noted that many important public health advances have been developed on the basis of statistical or epidemiologic information.

Copies of the Surgeon General's statement, together with supplementary data, will be made available to State health officers and others in the health professions as a further step in bringing the matter of smoking and cancer of the lung to public attention.

Dr. Burney said it is clear that cigarette smoking is not the only causative factor in cancer of the lung. Furthermore, the precise factors in cigarette smoking which can cause cancer of the lung are not known. He said more research is needed to identify and try to eliminate these factors. He also called for more research into other probable causes of cancer of the lung, including air pollution.

The United States now has more than 25,000

CONTINUED ON PAGE 56

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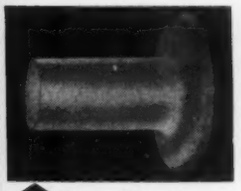

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deaths each year from cancer of the lung. How many of these persons were heavy cigarette smokers is not known. Altogether, deaths from cancer make up about 250,000 of the 1.6 million total deaths in the United States each year.

A new film that shows physicians how to avoid the recurrent headache of medical practice today—the professional liability claim—is now available from the American Medical Association film library for county society and other professional bookings.

Titled "The Doctor Defendant," the new film was premiered in June in the New York Coliseum before a large audience of physicians attending the 106th annual meeting of the A. M. A. The 34-minute black and white sound film is the second in the "Medicine and the Law" film series produced by the Wm. S. Merrell Company, ethical pharmaceutical laboratories of Cincinnati, Ohio, in cooperation with the A. M. A. and the American Bar Association.

The new movie presents in concise and dramatic terms the stories of four doctors who find themselves cast in the disturbing role of "The Doctor Defendant." In reviewing these cases, the film also demonstrates how a county medical society professional liability review committee functions.

Medical societies may book "The Doctor Defendant" from the A. M. A. film library for showings before their own members. "The Doctor Defendant" is a companion film to "The Medical Witness" which depicts right and wrong methods of presenting medical testimony by re-enacting a personal injury trial. Both films can be booked together as part of a legal medicine seminar.

Produced as a service to the medical and legal professions, "The Doctor Defendant" presents four cases which are among the most frequently encountered and most representative of what the physician has to face.

A TOTAL of $187,358 was awarded to seventy scientists in colleges and universities throughout the United States by Research Corporation during the second quarter of the year, Charles H. Schauer, Director of grants, reported recently.

This brings the half-year total to $351,541. Mr. Schauer explained that Research Corporation grants are aimed chiefly at initiating worth while fundamental research in science where, because often new and sometimes bold ideas are involved, support is hard to get.

At the same time, Research Corporation announced that its Williams-Waterman Fund for the Combat of Dietary Diseases has granted $109,242 to twenty-six scientists during the first six months of this year. Most of its contributions have been made for research in combating dietary deficiency diseases.

Neuritis may be due to mechanical pressure upon a nerve root as it issues from the spinal column. In that case a primary or secondary muscle spasm results which can be relieved by muscle relaxant drugs. Neuritis can also result from inflammation of the posterior nerve roots, which occurs in many patients one or two weeks after a severe upper respiratory or other virus infection.

In treating this inflammatory type of neuritis, Dr. Richard T. Smith, Director of the Department of Rheumatology, Benjamin Franklin Clinic, Philadelphia, recommends 1.3 cc. or one ampule of protamide® (Sherman) daily for five days, intramuscularly. "No further injections are given if pain has disappeared by this time," he says. If the pain persists, a second series of five daily treatments is given. After this ten-day period, if no improvement occurs, Smith believes "it should be discontinued and an error in diagnosis considered."

BENDECTIN was used in 205 patients for control of nausea and vomiting associated with pregnancy and motion sickness. Because of a special delayed action tablet coating, the medication was given at bedtime. The drug was released during sleep to control early morning distress of pregnant patients. Duration of bendectin therapy varied from a few days to 180 days. Complete symptomatic relief was obtained in 179 of the 205 patients and in twenty-five there was control of vomiting but nausea occasionally persisted. Two hundred of the cases reported were pregnancies. In eighty-eight there was a history of nausea and vomiting during a previous pregnancy. All but one of these women reported more satisfactory relief from bendectin than from medication used during previous pregnancy.

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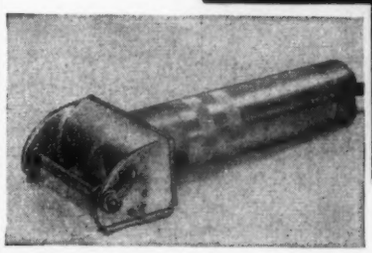

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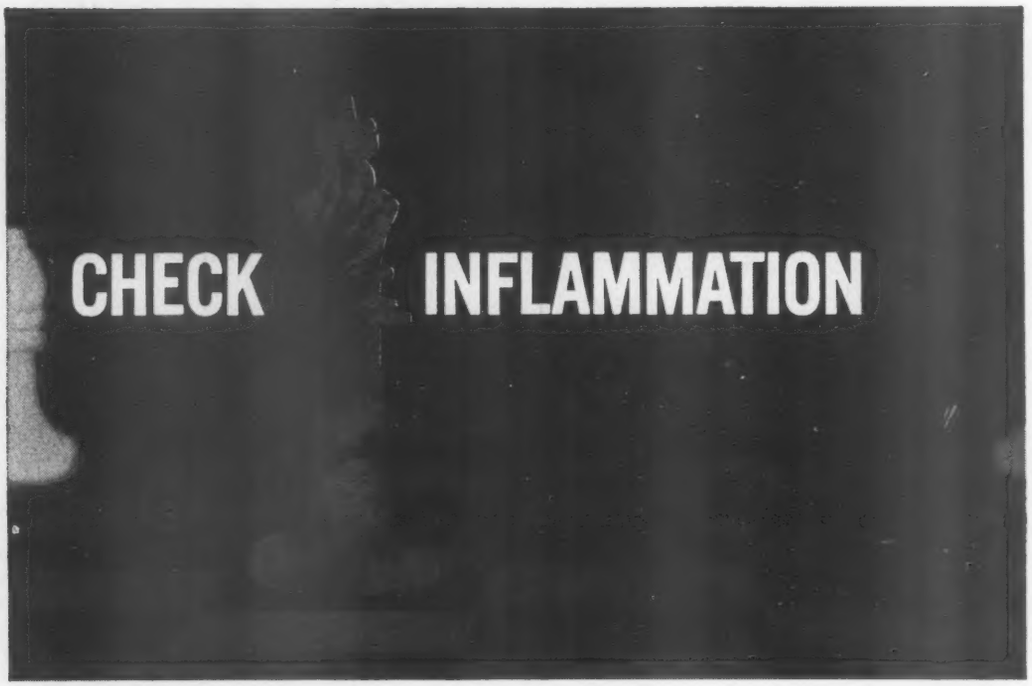

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1. Miller, J. M.; Surmonte, J. A.; Ginsberg, M., and Ablondi, F. B.: Postgraduate Medicine 20:260 (Sept.) 1956.

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AUTHORS: Belding H. Scribner, M.D., Director of Research, Seattle Veterans Hospital, and Assistant Professor of Medicine, University of Washington; Carl R. Hines, M.D., Instructor of Medicine, Northwestern University Medical School. Research supported in part by a grant from the American Heart Association.

The film demonstrates simple bedside tests for blood and urinary electrolytes. These tests permit the physician to solve difficult fluid balance problems quite promptly, and without requiring the services of a medical center.

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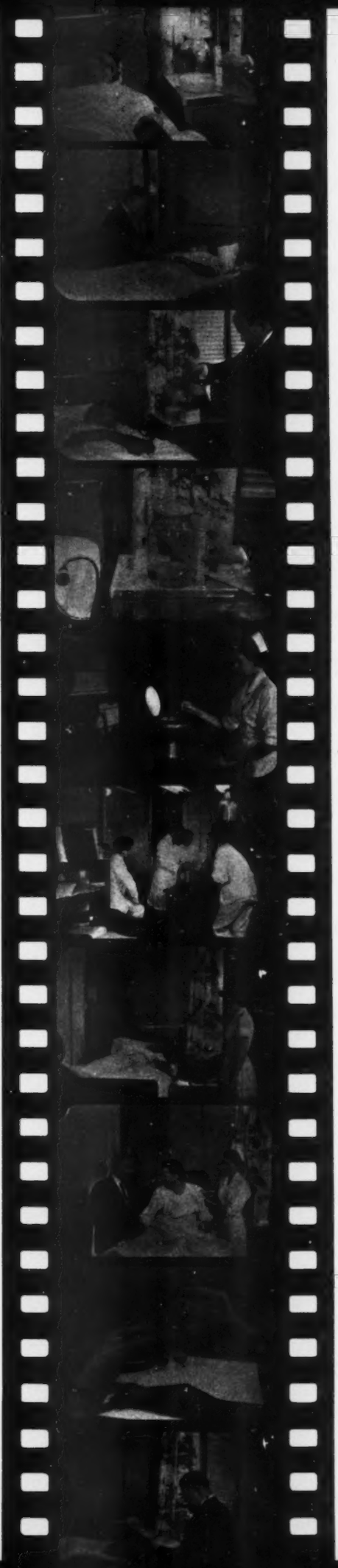

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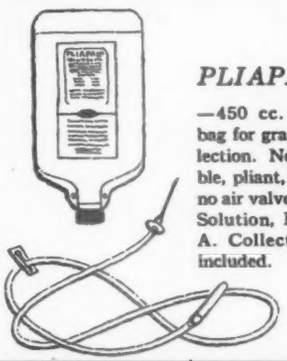

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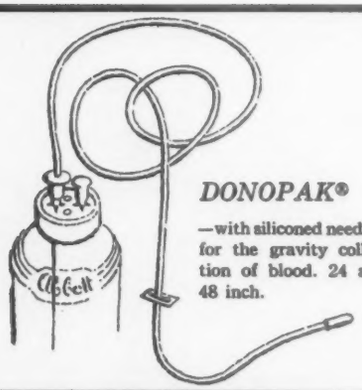

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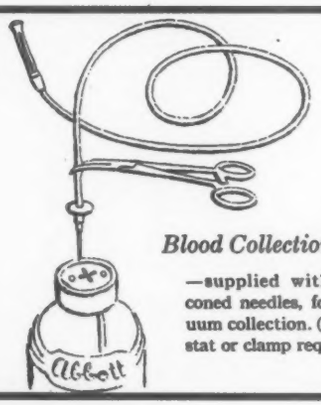

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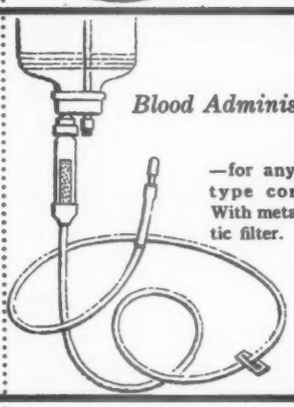
—supplied with siliconed needles, for vacuum collection. (Hemostat or clamp required.)



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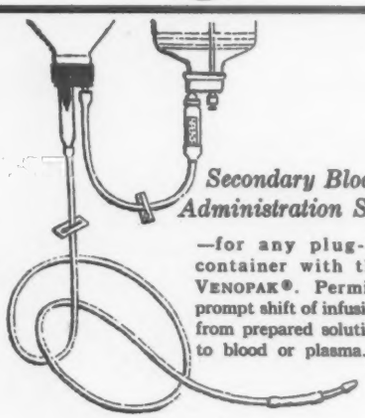

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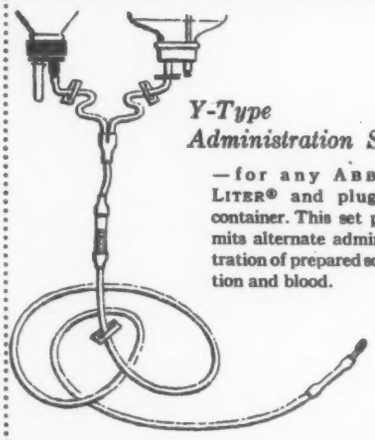
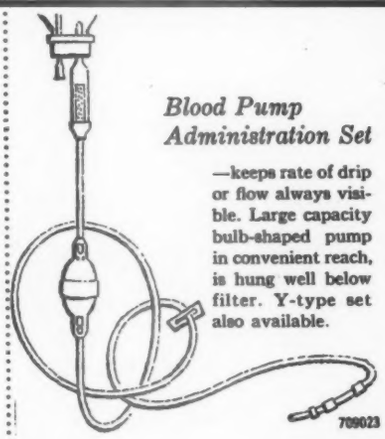


Y-Type Administration Set

—for any ABBO-LITER® and plug-in container. This set permits alternate administration of prepared solution and blood.



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